Organic Matter and Thermal Maturity Analyses of the Upper Cretaceous Sediments between 3,267 and 3,365 feet in the 1 Alpine Federal Well, Apache County, Arizona

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ORGANIC MATTER AND THERMAL MATURITY ANALYSES OF THE UPPER CRETACEOUS SEDIMENTS BETWEEN 3,267 AND 3,365 FEET IN THE SWTDI/NMSU NO.1 ALPINE-FEDERAL WELL, APACHE COUNTY, ARIZONA

PREPARED FOR
THE ARIZONA GEOLOGICAL SURVEY

by

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INTRODUCTION

Six core chip samples, AZ878-01 thru AZ878-06, taken from the interval between 3,267 and 3,365 feet in the SWTDI/NMSU No. 1 Alpine-Federal well, Apache County, Arizona, were analyzed for organic matter content (type and percent) and state of thermal maturity. Organic geochemical parameters, use by Geo-Strat, Inc., to define maturation, are based on Geo-Strat's visual spore-coloration interpretation (TAI), electronically measured color values derived from the Integrated Color Analysis via the Spectral Power Distribution of the transmitted light (ICA/SPD) and Vitrinite Reflectance (%Ro) determinations.

DISCUSSION

(ANALYTICAL METHODS)

Visual Kerogen

What is kerogen? Kerogen is the name given to the organic residue which is recovered after a sediment has been subjected to the extraction process. Extraction and preparation is a four step process. First the sediment is crushed and placed into a beaker of hydrochloric acid. This removes any carbonates which might be present. Once completed, the sample is washed and is ready for step two. In step two, the acidized residue is placed into a beaker of hydrofluoric acid. This removes most of the non-calcareous mineral debris thereby leaving behind the organic material which we call "kerogen". In step three, the organic matter is separated from the remaining

we call "kerogen". In step three, the organic matter is separated from the remaining mineral debris and concentrated, by flotation, in a heavy liquid (zinc bromide). Kerogen debris consists primarily of botanical and zoological elements such as trilete spores, pollen, fungal debris, plant tissue fragments, worms jaws (scolecodonts), foraminiferal linings, chitinozoans, graptolites, algal cysts, and a host of other components.

Geo-Strat's visual kerogen scheme is unique in that it was designed especially for the explorationist. In this system, kerogen parameters are presented numerically as an index value. This allows the various organic matter and thermal maturity data to be computerized and used in the preparation of local and/or regional "organic facies" maps. By keeping track of the various kerogen indices, the explorationist can define the margins of basins (configuration), the direction of sedimentary transport and, possibly, the prevailing water currents (circulation). Rapid changes in any of the various kerogen parameters (see the visual kerogen summary chart, Figure 1) may signify changes in climate and/or thermal heating (including volcanics, igneous intrusives, etc.). They might also aid the geologist in the recognition of a turbidite sequences, faults, unconformities and other geological events.

The visual kerogen format, as designed by Geo-Strat, Inc., is divided into several specific categories (Figure 1). These include: **Organic Matter Type (OMI)**, **Thermal Maturity (TAI)**, **Estimated Fluorescence (%Fl)**, **Kerogen Preservation (PI)** and **Kerogen Particle Size (PSI)**. Each of these, except estimated fluorescence, is defined by a numerical index value ranging from 1.00 to 8.00. [**NOTE**; estimated fluorescence has an index value of from 1.0 to 7.0.]

In using Geo-Strat's visual kerogen method, samples having low index values for organic matter type (OMI), thermal maturity (TAI), fluorescence (%Fl), preservation (PI), and particle size index (PSI), indicate that the organic constituents observed in that sample are predominantly "oil" prone, immature, hydrogen rich, well preserved and consist of finely disseminated particulate organic debris. On the other hand, high index values are indicative of a "gas" prone kerogen type which is overly mature, severely altered and/or metamorphosed. High values also indicate that the organics in the sediment are hydrogen poor, have a coarse particle size and are poorly preserved.

ICA/SPD Analysis

What is the ICA/SPD analysis? The ICA/SPD analysis is a new technique developed by Geo-Strat, Inc. which electronically measures the color of an organic constituent (kerogen) in transmitted illumination (Schwab et al., 1994a,b). ICA/SPD is the abbreviation for, Spectral Color Analysis via Spectral Power Distribution. The analysis of the visual kerogen slide is done microscopically, the color of the kerogen particle being determined with a spectral photometer. Prior to the ICA/SPD examination, the microscope system is calibrated using a series of narrow band-pass

filters. The filters,a series of seven, are calibrated between 350 and 750 nanometers and are representative of the visible light spectrum. From the acquired data (measured wavelengths) an organic constituents "color" is established. Color is defined by three basic attributes, hue, intensity (brightness) and saturation. Of these, only hue and intensity are used to calculate a constituents thermal alteration index (TAI) and an estimated vitrinite reflectance value. Saturation values don't add any significant value in defining TAI and estimated %Ro

Once a series of measurements has been taken on the organic constituents, spores, pollen and plant tissue fragments, the accumulated data is plotted on a hue verse intensity histogram (Figure 2). Based on a pre-defined series of polynomial regression curves, derived from the analyses of Staplin's (1969) original spore-coloration (TAI) standards, a sediments level of thermal maturity can be calculated.

Fluorescence (%Fl)

Fluorescence (%Fl) is the ability of the organic constituents to produce luminancence (visible light) when irradiated with Blue Light and UV excitation. Fluorescence is visibly intense (bright) in immature, oil prone, kerogens and declines as the organic constituents increase in maturity. Fluorescence become difficult to see (visually) when the level of thermal maturity progresses to about 1.15 %Ro and is essentially gone (or so weak as to appear absent) at a reflectance of 1.35 %Ro (at and/or near the "oil" death line).

Organics which exhibit good fluorescence capabilities are interpreted as being hydrogen rich (high in lipid content) while those which exhibit little to no fluorescence are interpreted as being hydrogen poor (low in lipid content). Fluorescence provides the analyst with the added capability of being able to tell whether the organics in a particular organic matter suite are likely to have been recycled, are more apt to be *in situ*, and/or if they have been affected by weathering.

Vitrinite Reflectance (%Ro)

Vitrinite reflectance is another method used by organic petrologists to define a sediments level of thermal maturity. Initially used by the coal industry to measure and/or define "coal rank", the technique was adopted by the petroleum industry in the mid-to-late 1960's as another means of determining thermal maturity. The technique, now a routine examination in most geological laboratories, involves measuring the reflectance of the organic constituent "vitrinite" in reflected light.

Stopes (1919) in her studies of bituminous coal, included vitrinite as one of the primary ingredients of coal. Over the years the classification of coal has been refined to the point where coal geologists now recognize three primary lithotypes; Vitrinite, Exinite and Inertinite (Stach, 1968). Although Stopes or Stach never pursued a

discussion on the evolution and/or geologic ranges of the maceral types, most coal petrologists (including some organic geochemists) believe that Vitrinite makes its first appearance in the Upper Silurian. They tie this event with that point in geologic time when trilete spores are thought to have evolved. This is also where and when the first "true" vascular land plants are thought to have made their initial appearance in the stratigraphic column.

Vitrinite consists of two basic types; Telinite and Collinite. Telinite is structured vitrinite. It often shows the outline of cells and cell walls and is assumed to represent the cellulosic portions of wood. Collinite, on the other hand, is the amorphous gel-like form of vitrinite. There are at least two forms of Collinite. One form we consider to be derived from the true vascular (terrestrial) plants, the other being derived from either the polymerization of resins, oils, ?Thallophytes (algae, fungi, bacteria) and primitive (early) ?vascular-like plants. There appears to be no single source from which Collinite is derived. To distinguish between pre-Upper Silurian Collinite and post-Upper Silurian Collinite, this author has labeled them as Collinite A and B. While their is no easy and/or definitive way to distinguish between the two forms microscopically, they can be identified chemically based on H/O ratios (Lewan and Buchardt, 1990).

Some analysts believe that what many are calling Vitrinite (Collinite type B) is in reality nothing more than fragments of graptolitic and/or chitinozoan debris. To make sure that one isn't making a mistake in identification, the analyst should always have a visual kerogen slide and vitrinite mount from the same residue. This allows the analyst an opportunity of examining the residue in transmitted as well as reflected light. Based on our observations, we regard the amorphous form of Vitrinite (Collinite type B) as a true form of the maceral Vitrinite and not graptolitic, chitinozoan and/or scolecodont debris. We also believe that Collinite type B has a geologic range from Precambrian to Recent (Figure 3).

When it comes to the identification of the various coal macerals in reflected illumination, through the microscope, the definition is fairly broad . This may not be a major problem when dealing with polished coal samples, but it does become problematic when analyzing finely disseminated particulate debris. In reflected light, using a 12 volt quartz halogen lighting source, Exinite can be characterized as being dark in color (almost black), Vitrinite as having a medium to light gray appearance and Inertinite as highly reflective and brilliant (silver to polished stainless steel in appearance). The identification of the macerals, with respect to their chemical composition, is more specific (Stach, 1968). Chemically, Exinite is defined as hydrogen rich, Vitrinite as oxygen rich and Inertinite as carbon rich.

RESULTS

(INTERPRETATION)

Organic Matter

The Visual Kerogen Summary Chart, Figure 1, illustrates the organic matter which was observed by Geo-Strat, Inc. in the samples collected the between 3,267 and 3,372 feet in the No. 1 Alpine-Federal well. With exception of the cored material from the intervals between 3,267 to 3,274 feet (sample AZ878-01) and 3,340 to 3,349 feet (sample AZ878-05), the organics consist primarily of finely disseminated amorphous debris (Amorphous Type 3) mixed with moderate percentages of plant tissue fragments and vitrinitic (woody) material. Algal cysts (marine dinoflagellates), fungal spores, trilete spores and tricolpate pollen are also present but in somewhat lesser amounts (see the visual kerogen computer print-out).

Sample AZ878-01 (3,267 to 3,274 feet) contains high percentages, $\pm$ 40%, of vitrinite. Sample AZ878-05 (3,340 to 3,348 feet) is dominated by fairly high percentages of vitrinitic debris and inerts (coaly material), $\pm$ 32% each. The high percentages of "gas" prone organics in these sample suggests that they were deposited in close proximity to the source (shallow open marine). Geo-Strat samples, AZ878-02 thru AZ878-04 (3,286 to 3,328 feet) and AZ878-06 (3,361.5 to 3,365 feet), also deposited in an open marine environment, are interpreted to have been deposited in a deeper water setting. The finer particle size of the organic debris in sample AZ878-02 (3,286 to 3,294 feet) and AZ878-06 (3,361.5 to 3,365 feet) also serves as an additional criterion for the organic constituents being deposited in moderately deep waters (the environment of deposition is interpreted as being further from the source and/or from the shoreline than the other four samples). It is possible that minor unconformities (and/or major lithologic changes) exist between the intervals 3,286' to 3,312' and 3,340' to 3,365' (samples AZ878-02 to AZ878-03 and AZ878-05 to AZ878-06). Although we suspect their presence, we have no concrete evidence as to their existence.

[**NOTE:** We base part of our interpretation on the occurrence of calcareous nannofossils. Although nannofossil preparations are generally not examined in routine organic matter studies, the abundance of marine dinoflagellates in the kerogen slides caused this writer to investigate further. While our paleontological data is sparse, the occurrence of the nannofossil *?Bukryaster (Discoaster) hayi*, in sample AZ878-03 (3,303 to 3,312 feet), assuming our identification is correct, indicates that this portion of the stratigraphic section is not older than ?Santonian to Campanian in age. This being true, the Upper Cretaceous in the No. 1 Alpine-Federal well is most likely a time equivalent, at least in part, of the upper Wepo Formation (upper Mancos), as illustrated by Nations (1989), and not Cenomanian (Dakota) as initially reported by the well site geologist (Rauzi, 1994a,b). Cepek and Hay (1969), initially reported *Bukryaster (Discoaster) hayi* from the Upper Cretaceous Selma Chalk (Arcola Ls. and

Demopolis Chalk members) of the Alabama. Sissingh (1977), restricts this particular form to sediments of early Campanian age.]

Thermal Maturity

Visual Kerogen (TAI)

As illustrated on Geo-Strat's Visual Kerogen Summary Chart, Figure 1, the kerogenaceous debris indicates that there are two or more levels of thermal maturity present throughout the Cretaceous section (Figure 1). Because these samples are core, the lowest thermal alteration index (TAI) must be interpreted as being *in situ*. The other maturation populations are interpreted as having been recycled from older sediments.

The majority of the organic debris in samples AZ878-01 thru AZ878-06 is pale yellow to yellow orange in color when viewed in transmitted illumination. This indicates that the stratigraphic section between 3,267 and 3,365 feet is immature insofar as its hydrocarbon generation capabilities are concerned. Although the sediments contain both "oil" prone and "gas" prone organics, the low levels of thermal maturity makes this section in the No. 1 Alpine-Federal well non-prospective for the commercial generation of liquid hydrocarbons.

ICA/SPD Measurements

Integrated color analysis, based on the spectral power distribution of the visible light spectrum, agrees well with the visual kerogen interpretation. The technique is a precise method which electronically measures the red, green and blue (R,G,B) components of the visible light spectrum which is being transmitted through an organic constituent. Once a series of readings have been taken, generally two readings per specimen, the acquired R,G,B, data is mathematically converted to hue and intensity values. It is from the hue and intensity that the TAI and estimated reflectance (%Roe) indices are derived. Geo-Strat's ICA/SPD values, acquired on the Upper Cretaceous samples from the No.1 Alpine-Federal well, are shown in Table 1. Our ICA/SPD data indicates that the Upper Cretaceous section, in this well, is extremely immature.

Fluorescence (%Fl)

The kerogen suite, representative of the Upper Cretaceous section of the No.1 Alpine-Federal, well exhibited poor to very poor fluorescence. This suggests that the organics have either a low hydrogen index and/or consist of high percentages of "gas" prone kerogenaceous debris. An alternative explanation could be that the bulk of the organics in this part of the stratigraphic section may have been reworked from older sediments and/or suffered from pre-depositional/post-depositional oxidation.

Vitrinite Reflectance (%Ro)

Vitrinitic debris is a common to abundant constituent throughout the Upper Cretaceous section in the No. 1 Alpine-Federal well. Although both types of Vitrinite (Telinite and Collinite) probably occur, the author only observed the amorphous form. All vitrinite reflectance measurements, %Ro, were made using standard petrological techniques. Acquired vitrinite reflectance (%Ro) measurements were taken from polished plugs using a Zeiss Universal Microscope equipped with a MP-100 photometer.

Vitrinite reflectance (%Ro) histograms for samples AZ878-01 thru AZ878-06 illustrates just how severe the problem of recycling is. Almost every sample contains a minimum of three to four maturation populations. This makes defining and selecting an *in situ* population difficult. [**NOTE**: Geo-Strat, Inc., is in agreement with Jarvies (1995) interpretation that much of the coaly material in the Upper Cretaceous represents nonautochthonous debris.]

Vitrinitic constituents observed in polished plugs and interpreted to be *in situ*, range between 0.40 and 0.45 %Ro for Geo-Strat samples AZ878-01 thru AZ878-04. Samples AZ878-05 and AZ878-06 had slightly more anomalous reflectance values of 0.32 and 0.64 %Ro respectively (see individual histograms). The overall average measured reflectance for the Upper Cretaceous section is 0.45 %Ro.

Estimated reflectance (%Roe) values, derived from the hue and intensity values using the ICA/SPD technique, illustrates what Geo-Strat considers to be a more accurate representation of what the "true" reflectance profile should look like (See the enclosed ICA/SPD reflectance histograms). Based on the ICA/SPD data, samples AZ878-01 thru AZ878-06 were interpreted to have estimated reflectance values of 0.37, 0.40, 0.41, 0.43, 0.42 and 0.45 % respectively. The overall average estimated reflectance is 0.41 %Roe.

Vitrinite reflectance data, regardless of having been derived from measure vitrinite particles in polished plugs or from estimates based on the hue and intensity parameters, supports Geo-Strat's interpretation for a grossly immature Upper Cretaceous section in the No. 1 Alpine-Federal well.

CONCLUSIONS

1. Organic constituents extracted from the Upper Cretaceous (?Santonian-Campanian) section, 3,267 to 3,365 feet, in the No. 1 Alpine-Federal well, indicates deposition in an open marine environment.

2. Visual kerogen TAI (spore-coloration) values, ICA/SPD color measurements and Vitrinite Reflectance (%Ro) determinations, indicates that the entire Upper Cretaceous sequence in the No. 1 Alpine-Federal well is at an immature state of thermal maturity.

3. Visual kerogen analyses, combined with estimated fluorescence, indicates that the organics present in the stratigraphic section between 3,267 and 3,365 in the No. 1 Alpine-Federal well are more "gas" prone than "oil" prone.

4. Assuming the organic constituents remain relatively the same, insofar as their relative percentages are concerned, this particular interval could be a source for either "oil" and/or "gas" at higher levels of thermal maturity (deeper basinal setting), e.g., greater than $\pm$ 0.95 %Ro.

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TABLE 1

SPD SUMMARY

File Name	Id/ Depth	Cts.	GSI	SSI	Est. % Ro		* Maturity of Organic Matter Type 1	Type 2	Type 3
AZ878-01	3267'-3274	78	2.32	1.43	0.37	+	Immat.	Immat.	Immat.
AZ878-02	3286'-3294	76	2.51	1.52	0.40	+	Immat.	Immat.	Immat.
AZ878-03	3303'-3312	85	2.55	1.54	0.41	+	Immat.	Immat.	Immat.
AZ878-04	3321'-3328	81	2.66	1.60	0.43	+	Immat.	Immat.	Immat.
AZ878-05	3340'-3349	82	2.61	1.58	0.42	+	Immat.	Immat.	Immat.
AZ878-06	3361.5-363	76	2.75	1.66	0.45	+	Immat.	Immat.	Immat.
AZ878-07	3372'	88	2.78	1.67	0.45	+	Immat.	Immat.	Immat.

GSI = GEO-STRAT THERMAL ALTERATION INDEX

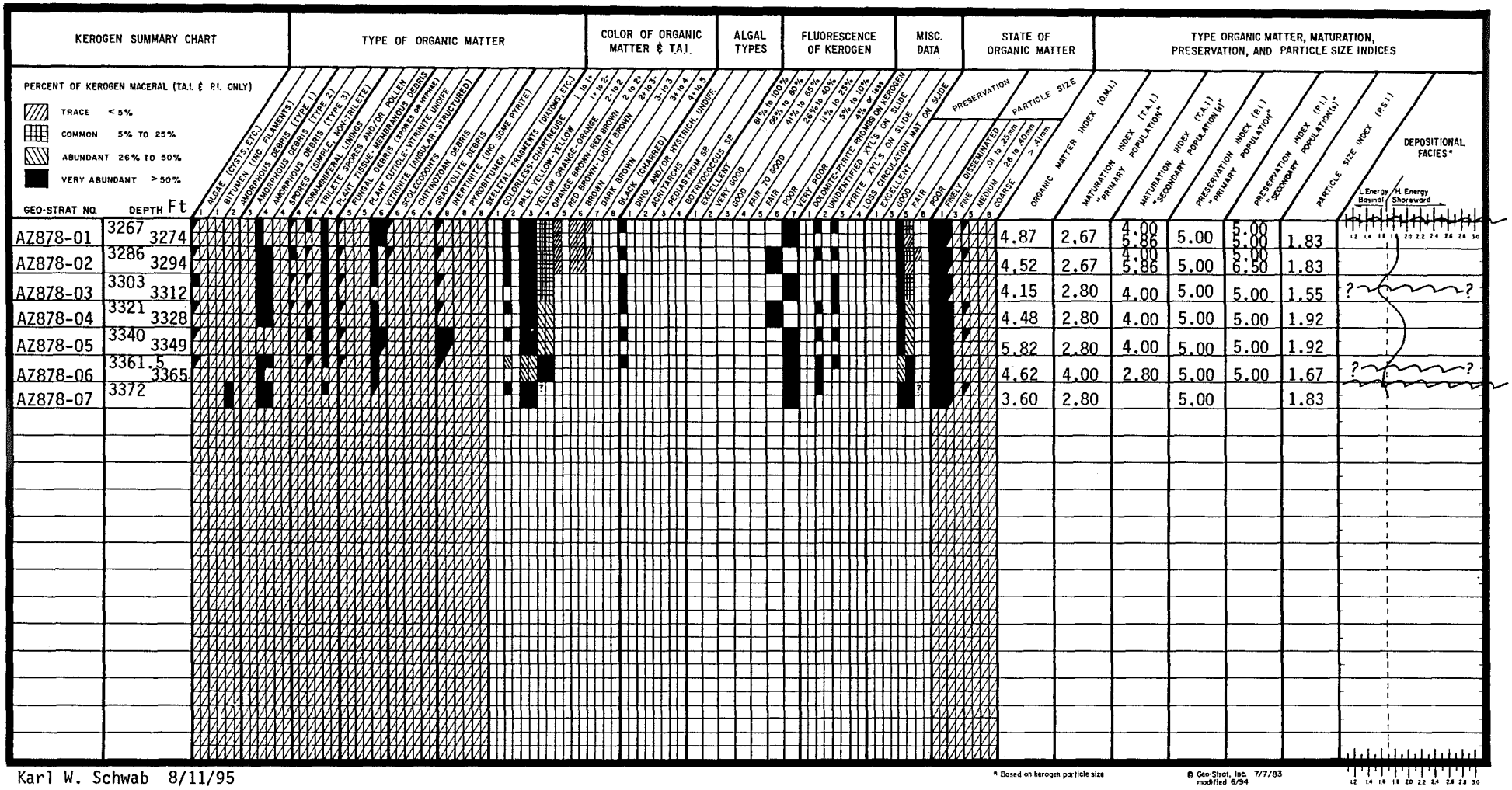
SSI = STAPLIN'S (1969) THERMAL ALTERATION INDEX (TAI)

(+) POPULATION CONSIDERED TO BE IN SITU

(*) FROM TISSOT and WELTE, 1978, P. 451

FIGURE 1

SWTDI/NMSU ALPINE #1 FEDERAL, APACHE CO., ARIZONA SEC: 23, T: 6N, R: 30E



Karl W. Schwab 8/11/95

* Based on kerogen particle size

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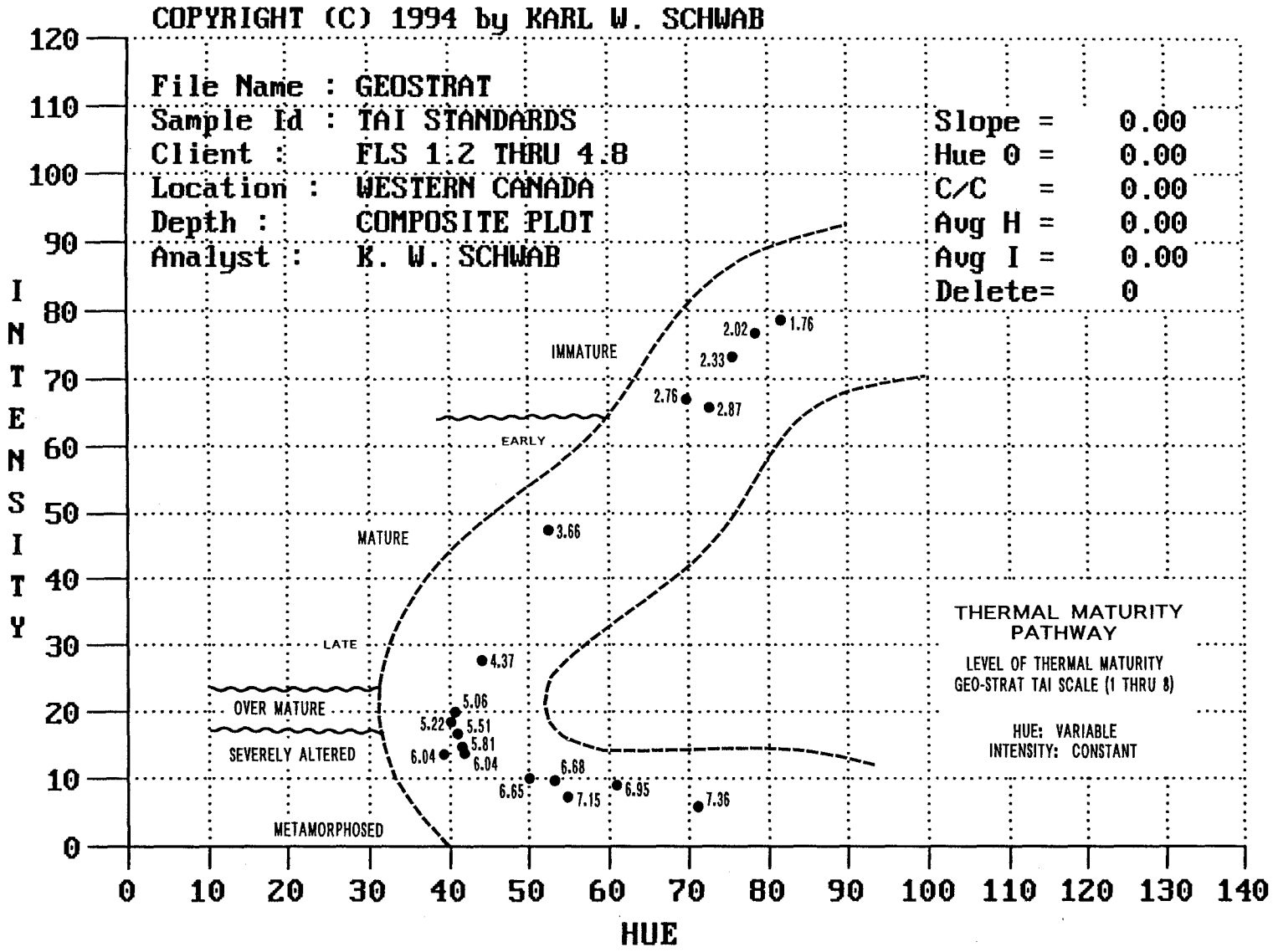
FIGURE 2a


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : GEOSTRAT
Sample Id : TAI STANDARDS
Client : FLS 1.2 THRU 4.8
Location : WESTERN CANADA
Depth : COMPOSITE PLOT
Analyst : K. W. SCHWAB
Slope = 0.00
Hue 0 = 0.00
C/C = 0.00
Avg H = 0.00
Avg I = 0.00
Delete= 0
IMMATURE
EARLY
MATURE
LATE
OVER MATURE
SEVERELY ALTERED
METAMORPHOSED
THERMAL MATURITY PATHWAY
LEVEL OF THERMAL MATURITY
GEO-STRAT TAI SCALE (1 THRU 8)
HUE: VARIABLE
INTENSITY: CONSTANT
INTENSITY
HUE
0 10 20 30 40 50 60 70 80 90 100 110 120
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
1.76
2.02
2.33
2.76
2.87
3.66
4.37
5.06
5.22
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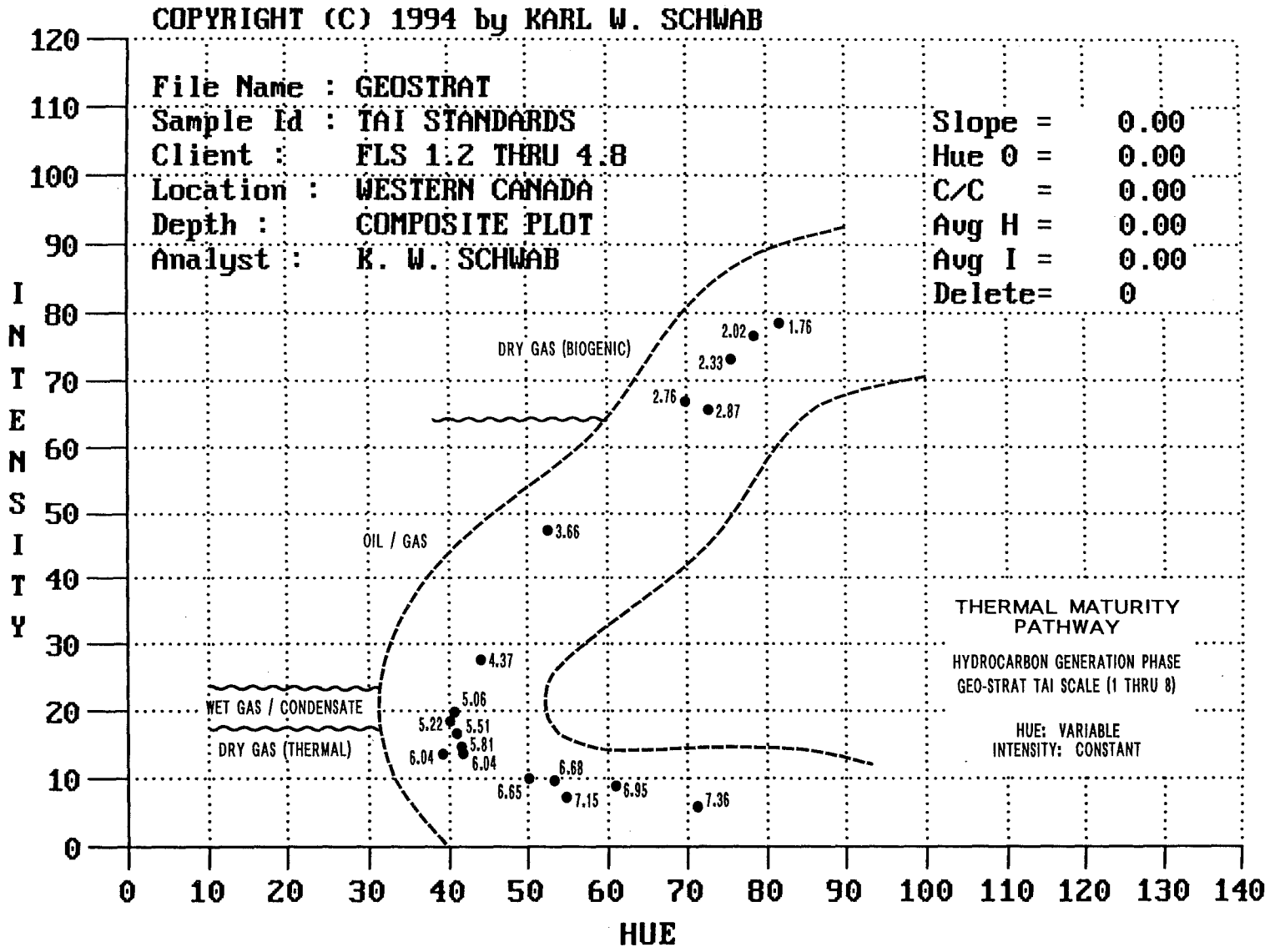
5.81
6.04
6.04
6.65
6.68
7.15
6.95
7.36

FIGURE 2b


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : GEOSTRAT
Sample Id : TAI STANDARDS
Client : FLS 1.2 THRU 4.8
Location : WESTERN CANADA
Depth : COMPOSITE PLOT
Analyst : K. W. SCHWAB
Slope = 0.00
Hue 0 = 0.00
C/C = 0.00
Avg H = 0.00
Avg I = 0.00
Delete= 0
DRY GAS (BIOGENIC)
OIL / GAS
WET GAS / CONDENSATE
DRY GAS (THERMAL)
THERMAL MATURITY PATHWAY
HYDROCARBON GENERATION PHASE
GEO-STRAT TAI SCALE (1 THRU 8)
HUE: VARIABLE
INTENSITY: CONSTANT
INTENSITY
HUE
0 10 20 30 40 50 60 70 80 90 100 110 120
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
1.76
2.02
2.33
2.76
2.87
3.66
4.37
5.06
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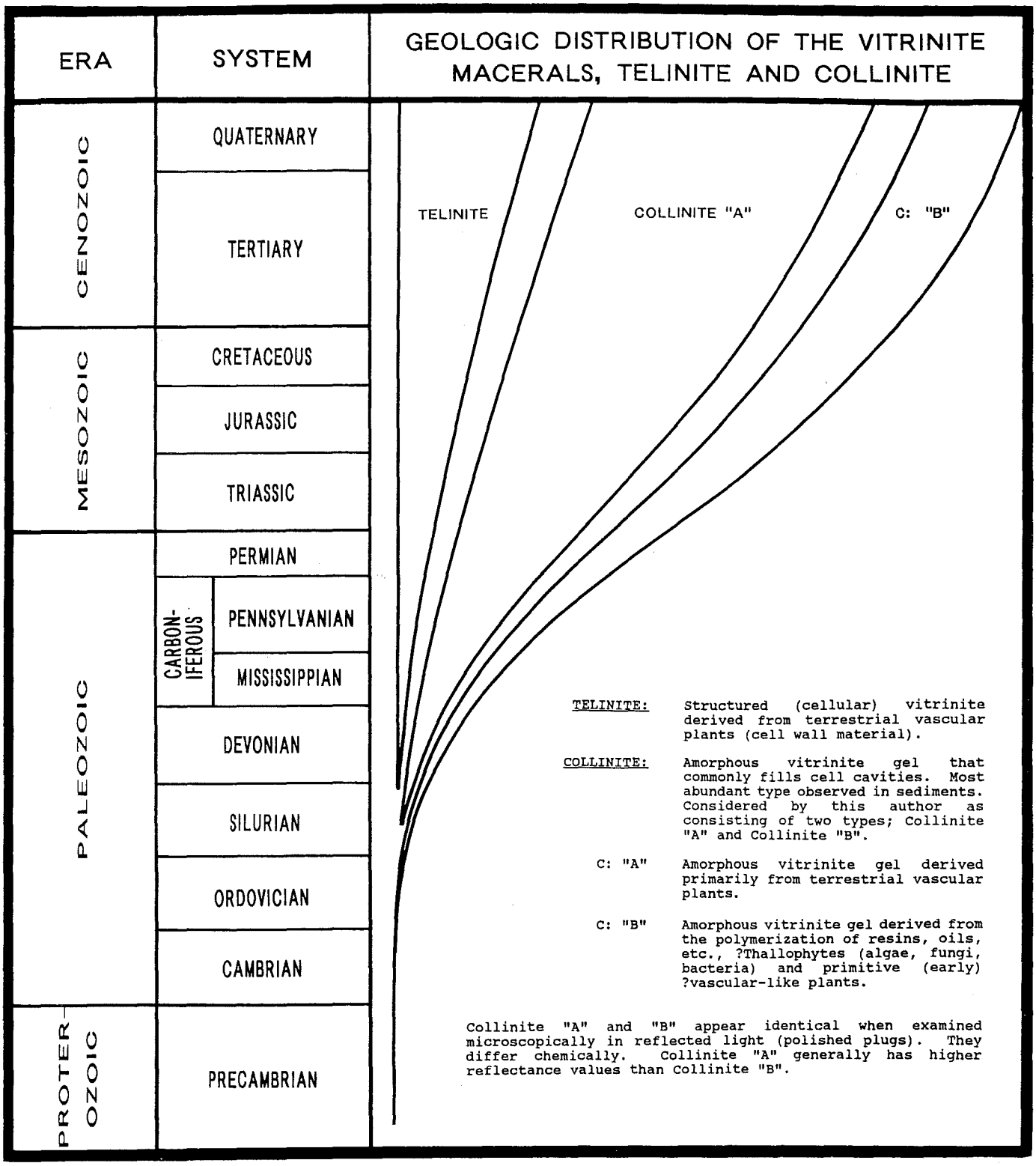
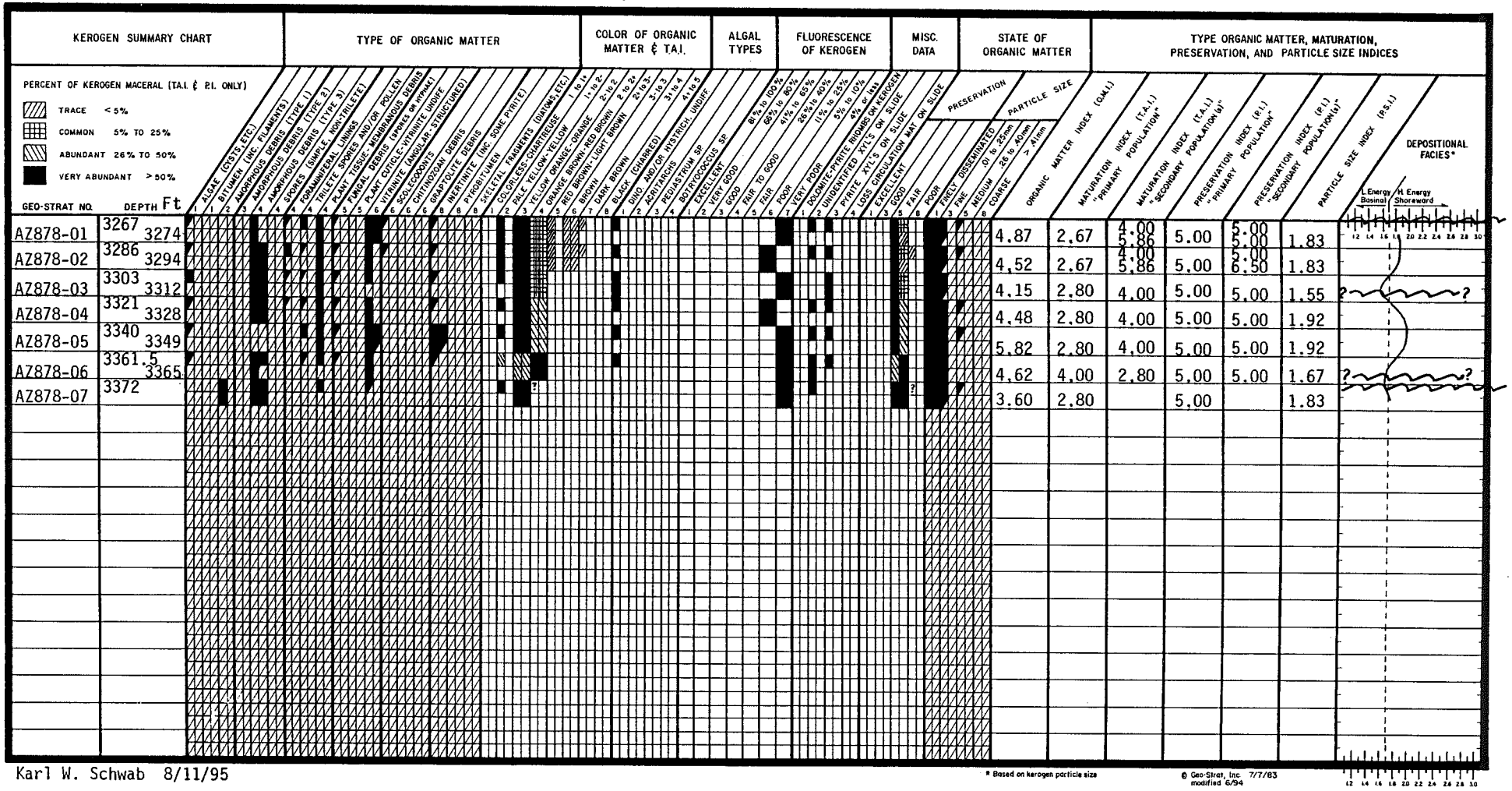
6.04
6.04
6.65
6.68
7.15
6.95
7.36

FIGURE 3



VISUAL KEROGEN DATA
(TAI)

SWTDI/NMSU ALPINE #1 FEDERAL, APACHE CO., ARIZONA SEC: 23, T: 6N, R: 30E



Karl W. Schwab 8/11/95

* Based on kerogen particle size

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-01

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-01
ANALYST..... K. W. SCHWAB
DEPTH..... 3,267'-3,274'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-01
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

4%	Algae (Cysts, etc.)	4%	Fungal Debris (Spores and/or Hyphae)
	Bitumen (Inc. Fibrils)		Thick Cuticle-Vitrinite Undiff.
	Amorphous Type 1 (Massive-Fluffy)	35%	Vitrinite (Angular-Structured)
	Amorphous Type 2 (Globular)	4%	Scolecodonts (Worms Jaws)
17%	Amorphous Type 3 (Finely Disseminated)		Chitinozoan Debris
	Spores (Simple, Non-Trilete)		Graptolite Debris
4%	Foraminiferal Linings	4%	Inertinite (Inc. Pyrite)
9%	Trilete Spores and/or Pollen		Pyrobitumen
17%	Plant Tissue-Membranous Debris		Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.67	>50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	5-25%	trilete spores/pollen	Mature (Late)
3. (Sec)	3- to 3	5.86	0-4%	amorphous debris	OM - Severely Altered

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	4.87	Very Poor	0% to 4%	1.83	Pop. 1 5.00
					Pop. 2 5.00
					Pop. 3 5.00

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Trace
Pyrite crystals on kerogen slide - Trace

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-02

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-02
ANALYST..... K. W. SCHWAB
DEPTH..... 3,286'-3,294'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-02
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

4%	Algae (Cysts, etc.)	4%	Fungal Debris (Spores and/or Hyphae)
	Bitumen (Inc. Fibrils)		Thick Cuticle-Vitrinite Undiff.
	Amorphous Type 1 (Massive-Fluffy)	17%	Vitrinite (Angular-Structured)
	Amorphous Type 2 (Globular)	4%	Scolecodonts (Worms Jaws)
35%	Amorphous Type 3 (Finely Disseminated)		Chitinozoan Debris
	Spores (Simple, Non-Trilete)		Graptolite Debris
9%	Foraminiferal Linings	4%	Inertinite (Inc. Pyrite)
4%	Trilete Spores and/or Pollen		Pyrobitumen
17%	Plant Tissue-Membranous Debris		Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.67	>50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	5-25%	trilete spores/pollen	Mature (Late)
3. (Sec)	3- to 3	5.86	0-4%	amorphous debris	OM - Severely Altered

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	4.52	Very Poor	5% to 10%	1.83	Pop. 1 5.00 Pop. 2 5.00 Pop. 3 6.50

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Trace
Pyrite crystals on kerogen slide - Trace

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-03

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-03
ANALYST..... K. W. SCHWAB
DEPTH..... 3,303'-3,312'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-03
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

10% Algae (Cysts, etc.)
Bitumen (Inc. Fibrils)
Amorphous Type 1 (Massive-Fluffy)
Amorphous Type 2 (Globular)
40% Amorphous Type 3 (Finely Disseminated)
Spores (Simple, Non-Trilete)
5% Foraminiferal Linings
5% Trilete Spores and/or Pollen
20% Plant Tissue-Membranous Debris
5% Fungal Debris (Spores and/or Hyphae)
Thick Cuticle-Vitrinite Undiff.
10% Vitrinite (Angular-Structured)
Scolecodonts (Worms Jaws)
Chitinozoan Debris
Graptolite Debris
5% Inertinite (Inc. Pyrite)
Pyrobitumen
Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.80	>50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	5-25%	trilete spores/pollen	Mature (Late)

ADDITIONAL PARAMETERS

TOC	OMI	OOM (oil proneness)	%FL	PSI	PI
n.a.	4.15	Very Poor	0% to 4%	1.55	Pop. 1 5.00 Pop. 2 8.00

COMMENTS

ACCESSORY MINERALS
Pyrite crystals on kerogen slide - Rare

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-04

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-04
ANALYST..... K. W. SCHWAB
DEPTH..... 3,321'-3,328'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-04
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

5% Algae (Cysts, etc.)
Bitumen (Inc. Fibrils)
Amorphous Type 1 (Massive-Fluffy)
Amorphous Type 2 (Globular)
38% Amorphous Type 3 (Finely Disseminated)
Spores (Simple, Non-Trilete)
5% Foraminiferal Linings
5% Trilete Spores and/or Pollen
19% Plant Tissue-Membranous Debris

5% Fungal Debris (Spores and/or Hyphae)
Thick Cuticle-Vitrinite Undiff.
19% Vitrinite (Angular-Structured)
Scolecodonts (Worms Jaws)
Chitinozoan Debris
Graptolite Debris
5% Inertinite (Inc. Pyrite)
Pyrobitumen
Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.80	>50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	26-50%	trilete spores/pollen	Mature (Late)

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	4.48	Very Poor	5% to 10%	1.92	Pop. 1 5.00 Pop. 2 5.00

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Trace
Pyrite crystals on kerogen slide - Trace

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-05

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-05
ANALYST..... K. W. SCHWAB
DEPTH..... 3,340'-3,349'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-05
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

5% Algae (Cysts, etc.)
Bitumen (Inc. Fibrils)
Amorphous Type 1 (Massive-Fluffy)
Amorphous Type 2 (Globular)
Amorphous Type 3 (Finely Disseminated)
Spores (Simple, Non-Trilete)
Foraminiferal Linings
9% Trilete Spores and/or Pollen
18% Plant Tissue-Membranous Debris
5% Fungal Debris (Spores and/or Hyphae)
Thick Cuticle-Vitrinite Undiff.
32% Vitrinite (Angular-Structured)
Scolecodonts (Worms Jaws)
Chitinozoan Debris
Graptolite Debris
32% Inertinite (Inc. Pyrite)
Pyrobitumen
Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.80	>50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	26-50%	trilete spores/pollen	Mature (Late)

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	5.82	Very Poor	0% to 4%	1.92	Pop. 1 5.00 Pop. 2 5.00

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Trace
Pyrite crystals on kerogen slide - Trace

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-06

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-06
ANALYST..... K. W. SCHWAB
DEPTH..... 3,361.5'-3,365'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-06
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... CRETACEOUS
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

6%	Algae (Cysts, etc.)	6%	Fungal Debris (Spores and/or Hyphae)
	Bitumen (Inc. Fibrils)		Thick Cuticle-Vitrinite Undiff.
	Amorphous Type 1 (Massive-Fluffy)	25%	Vitrinite (Angular-Structured)
	Amorphous Type 2 (Globular)		Scolecodonts (Worms Jaws)
38%	Amorphous Type 3 (Finely Disseminated)		Chitinozoan Debris
	Spores (Simple, Non-Trilete)		Graptolite Debris
	Foraminiferal Linings	6%	Inertinite (Inc. Pyrite)
6%	Trilete Spores and/or Pollen		Pyrobitumen
13%	Plant Tissue-Membranous Debris		Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.80	26-50%	trilete spores/pollen	Immature
2. (Sec)	2 to 2+	4.00	>50%	trilete spores/pollen	Mature (Late)

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	4.62	Very Poor	0% to 4%	1.67	Pop. 1 5.00
					Pop. 2 5.00

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Rare
Pyrite crystals on kerogen slide - Trace

VISUAL KEROGEN SUMMARY CHART

Sample Number AZ878-07

CLIENT..... ARIZONA GEOLOGICAL SURVEY
FILE ID..... AZ878-07
ANALYST..... K. W. SCHWAB
DEPTH..... 3,372'
TYPE SAMPLE..... CORE

CLIENT ID..... AZ878-07
WELL NAME..... 1 ALPINE-FEDERAL
DATE..... 08-11-95
FORMATION/AGE..... ?PERMIAN
LOCATION/COUNTRY.... APACHE CO., ARIZONA

PERCENT ORGANIC CONSTITUENTS (approximate)

	Algae (Cysts, etc.)		Fungal Debris (Spores and/or Hyphae)
	Bitumen (Inc. Fibrils)		Thick Cuticle-Vitrinite Undiff.
27%	Amorphous Type 1 (Massive-Fluffy)	7%	Vitrinite (Angular-Structured)
	Amorphous Type 2 (Globular)		Scolecodonts (Worms Jaws)
53%	Amorphous Type 3 (Finely Disseminated)		Chitinozoan Debris
	Spores (Simple, Non-Trilete)		Graptolite Debris
	Foraminiferal Linings		Inertinite (Inc. Pyrite)
	Trilete Spores and/or Pollen		Pyrobitumen
13%	Plant Tissue-Membranous Debris		Skeletal Fragments (Diatoms, etc.)

THERMAL MATURITY INDEX (TAI)

Population	Staplin Expanded	Geo-Strat Inc.	% of Maceral	TAI color based on	State of Maturity
1. (Pri)	2- to 2	2.80	>50%	plant tissue	Immature

ADDITIONAL PARAMETERS

TOC	OMI	QOM (oil proneness)	%FL	PSI	PI
n.a.	3.60	Very Poor	0% to 4%	1.83	Pop. 1 5.00

COMMENTS

ACCESSORY MINERALS

Unid. crystals on kerogen slide - Trace

STRATIGRAPHIC INTERVAL SUMMARY
(TAI)

CLIENT..... ARIZONA GEOLOGICAL SURVEY
ANALYST..... KARL W. SCHWAB
INT. SUMMARIZED..... 3,267.0' THRU 3,372.0'
DATE..... 08-11-95
COUNTY/PROVINCE..... APACHE

CLIENT JOB NO/ID.... AZ878-01 THRU AZ878-07
TYPE SAMPLE..... CORE CHIP
FORMATION/AGE..... CRETACEOUS - ?U. PERMIAN
WELL NAME..... 1 ALPINE-FEDERAL
STATE/COUNTRY..... ARIZONA

FILE ID	CLIENT ID	DEPTH	POP	GEO-ST	STAP(E)	MAC %
AZ878-01	AZ878-01	3,267'-3,274'	1	2.67	2- to 2	>50%
			2	4.00	2 to 2+	5%-25%
			3	5.86	3- to 3	<5%
AZ878-02	AZ878-02	3,286'-3,294'	1	2.67	2- to 2	>50%
			2	4.00	2 to 2+	5%-25%
			3	5.86	3- to 3	<5%
AZ878-03	AZ878-03	3,303'-3,312'	1	2.80	2- to 2	>50%
			2	4.00	2 to 2+	5%-25%
AZ878-04	AZ878-04	3,321'-3,328'	1	2.80	2- to 2	>50%
			2	4.00	2 to 2+	26%-50%
AZ878-05	AZ878-05	3,340'-3,349'	1	2.80	2- to 2	>50%
			2	4.00	2 to 2+	26%-50%
AZ878-06	AZ878-06	3,361.5'-3,365'	1	2.80	2- to 2	26%-50%
			2	4.00	2 to 2+	>50%
AZ878-07	AZ878-07	3,372'	1	2.80	2- to 2	>50%

AVERAGES	POP	GEO-ST	STAP(E)	MAC %
	1.0	2.76	2- to 2	>50%
	2.0	4.00	2 to 2+	26%-50%
	3.0	5.86	3- to 3	<5%

STRATIGRAPHIC INTERVAL SUMMARY
(Kerogen Parameters)

CLIENT..... ARIZONA GEOLOGICAL SURVEY
ANALYST..... KARL W. SCHWAB
INT. SUMMARIZED..... 3,267.0' THRU 3,372.0'
DATE..... 08-11-95
COUNTY/PROVINCE..... APACHE

CLIENT JOB NO/ID.... AZ878-01 THRU AZ878-07
TYPE SAMPLE..... CORE CHIP
FORMATION/AGE..... CRETACEOUS - ?U. PERMIAN
WELL NAME..... 1 ALPINE-FEDERAL
STATE/COUNTRY..... ARIZONA

FILE ID	CLIENT ID	DEPTH	TOC	OMI	PSI	PI	%FL	QOM
AZ878-01	AZ878-01	3,267'-3,274'	n.a.	4.87	1.83	5.00	2	Very Poor
AZ878-02	AZ878-02	3,286'-3,294'	n.a.	4.52	1.83	5.00	8	Very Poor
AZ878-03	AZ878-03	3,303'-3,312'	n.a.	4.15	1.55	5.00	2	Very Poor
AZ878-04	AZ878-04	3,321'-3,328'	n.a.	4.48	1.92	5.00	8	Very Poor
AZ878-05	AZ878-05	3,340'-3,349'	n.a.	5.82	1.92	5.00	2	Very Poor
AZ878-06	AZ878-06	3,361.5'-3,365'	n.a.	4.62	1.67	5.00	2	Very Poor
AZ878-07	AZ878-07	3,372'	n.a.	3.60	1.83	5.00	2	Very Poor
		AVERAGES	TOC	OMI	PSI	PI	%FL	QOM
			n.a.	4.58	1.79	5.00	4	Very Poor

STRATIGRAPHIC INTERVAL SUMMARY
(% Organic Matter Constituents)

CLIENT..... ARIZONA GEOLOGICAL SURVEY
ANALYST..... KARL W. SCHWAB
INT. SUMMARIZED..... 3,267.0' THRU 3,372.0'
DATE..... 08-11-95
COUNTY/PROVINCE..... APACHE

CLIENT JOB NO/ID.... AZ878-01 THRU AZ878-07
TYPE SAMPLE..... CORE CHIP
FORMATION/AGE..... CRETACEOUS - ?U. PERMIAN
WELL NAME..... 1 ALPINE-FEDERAL
STATE/COUNTRY..... ARIZONA

FILE ID	CLIENT ID	DEPTH	AL FN	BT C-V	AM(1) VT	AM(2) SC	AM(3) CH	SS GR	FM IN	S-P PY	PT SK
AZ878-01	AZ878-01	3,267'-3,274'	4	0	0	0	17	0	4	9	17
			4	0	35	4	0	0	4	0	0
AZ878-02	AZ878-02	3,286'-3,294'	4	0	0	0	35	0	9	4	17
			4	0	17	4	0	0	4	0	0
AZ878-03	AZ878-03	3,303'-3,312'	10	0	0	0	40	0	5	5	20
			5	0	10	0	0	0	5	0	0
AZ878-04	AZ878-04	3,321'-3,328'	5	0	0	0	38	0	5	5	19
			5	0	19	0	0	0	5	0	0
AZ878-05	AZ878-05	3,340'-3,349'	5	0	0	0	0	0	0	9	18
			5	0	32	0	0	0	32	0	0
AZ878-06	AZ878-06	3,361.5'-3,365'	6	0	0	0	38	0	0	6	13
			6	0	25	0	0	0	6	0	0
AZ878-07	AZ878-07	3,372'	0	0	27	0	53	0	0	0	13
			0	0	7	0	0	0	0	0	0
		AVERAGES(%)	AL FN	BT C-V	AM(1) VT	AM(2) SC	AM(3) CH	SS GR	FM IN	S-P PY	PT SK
			5	0	4	0	32	0	3	5	17
			4	0	21	1	0	0	8	0	0

STRATIGRAPHIC INTERVAL SUMMARY
(% Organic Matter Constituents by Category)

CLIENT..... ARIZONA GEOLOGICAL SURVEY
ANALYST..... KARL W. SCHWAB
INT. SUMMARIZED..... 3,267.0' THRU 3,372.0'
DATE..... 08-11-95
COUNTY/PROVINCE..... APACHE

CLIENT JOB NO/ID.... AZ878-01 THRU AZ878-07
TYPE SAMPLE..... CORE CHIP
FORMATION/AGE..... CRETACEOUS - ?U. PERMIAN
WELL NAME..... 1 ALPINE-FEDERAL
STATE/COUNTRY..... ARIZONA

FILE ID	CLIENT ID	DEPTH	Algal Debris	Bitumen	Am. Debris	Plant Debris	Fungal Debris	Vit.	Inerts	Misc
AZ878-01	AZ878-01	3,267'-3,274'	4	0	17	26	4	35	4	9
AZ878-02	AZ878-02	3,286'-3,294'	4	0	35	22	4	17	4	13
AZ878-03	AZ878-03	3,303'-3,312'	10	0	40	25	5	10	5	5
AZ878-04	AZ878-04	3,321'-3,328'	5	0	38	24	5	19	5	5
AZ878-05	AZ878-05	3,340'-3,349'	5	0	0	27	5	32	32	0
AZ878-06	AZ878-06	3,361.5'-3,365'	6	0	38	19	6	25	6	0
AZ878-07	AZ878-07	3,372'	0	0	80	13	0	7	0	0

	AVERAGES(%)	Algal Debris	Bitumen	Am. Debris	Plant Debris	Fungal Debris	Vit.	Inerts	Misc
		5	0	35	22	4	21	8	5

STRATIGRAPHIC INTERVAL SUMMARY
Organic Matter Type - Hydrocarbon Generation
(Approximate Percent)

CLIENT..... ARIZONA GEOLOGICAL SURVEY
ANALYST..... KARL W. SCHWAB
INT. SUMMARIZED..... 3,267.0' THRU 3,372.0'
DATE..... 08-11-95
COUNTY/PROVINCE..... APACHE

CLIENT JOB NO/ID.... AZ878-01 THRU AZ878-07
TYPE SAMPLE..... CORE CHIP
FORMATION/AGE..... CRETACEOUS - ?U. PERMIAN
WELL NAME..... 1 ALPINE-FEDERAL
STATE/COUNTRY..... ARIZONA

FILE ID	CLIENT ID	DEPTH	OIL PRONE ORGANICS	OIL - GAS PRONE ORGANICS	GAS PRONE ORGANICS
AZ878-01	AZ878-01	3,267'-3,274'	4.35	52.17	43.48
AZ878-02	AZ878-02	3,286'-3,294'	4.35	69.57	26.09
AZ878-03	AZ878-03	3,303'-3,312'	10.00	75.00	15.00
AZ878-04	AZ878-04	3,321'-3,328'	4.76	71.43	23.81
AZ878-05	AZ878-05	3,340'-3,349'	4.55	31.82	63.64
AZ878-06	AZ878-06	3,361.5'-3,365'	6.25	62.50	31.25
AZ878-07	AZ878-07	3,372'	26.67	66.67	6.67

AVERAGES(%)	OIL PRONE ORGANICS	OIL - GAS PRONE ORGANICS	GAS PRONE ORGANICS
	8.70	61.31	29.99

INTEGRATED COLOR ANALYSIS DATA (ICA/SPD)

TABLE 1

SPD SUMMARY

File Name	Id/ Depth	Cts.	GSI	SSI	Est. % Ro		* Maturity of Organic Matter Type 1	Type 2	Type 3
AZ878-01	3267'-3274	78	2.32	1.43	0.37	+	Immat.	Immat.	Immat.
AZ878-02	3286'-3294	76	2.51	1.52	0.40	+	Immat.	Immat.	Immat.
AZ878-03	3303'-3312	85	2.55	1.54	0.41	+	Immat.	Immat.	Immat.
AZ878-04	3321'-3328	81	2.66	1.60	0.43	+	Immat.	Immat.	Immat.
AZ878-05	3340'-3349	82	2.61	1.58	0.42	+	Immat.	Immat.	Immat.
AZ878-06	3361.5-363	76	2.75	1.66	0.45	+	Immat.	Immat.	Immat.
AZ878-07	3372'	88	2.78	1.67	0.45	+	Immat.	Immat.	Immat.

GSI = GEO-STRAT THERMAL ALTERATION INDEX

SSI = STAPLIN'S (1969) THERMAL ALTERATION INDEX (TAI)

(+) POPULATION CONSIDERED TO BE IN SITU

(*) FROM TISSOT and WELTE, 1978, P. 451

STRATIGRAPHIC PROFILE TABLE
(THERMAL MATURITY)

CLIENT ID..... ARIZ. GEOL. SURVEY
FILE NAME/NO..... AZ-SPD-A
WELL NAME..... #1 ALPINE-FEDERAL
WELL OPERATOR.... SWTDI/NMSU
TYPE SAMPLES..... CORE CHIP
ANALYST..... K. W. SCHWAB

STATE..... ARIZONA
COUNTY..... APACHE
LOCATION..... T 6N, R 30E, SEC 23
AVG. DEPTH INTERVAL. 18
NO. VALUES PLOTTED.. 6
DATE..... 08-22-95

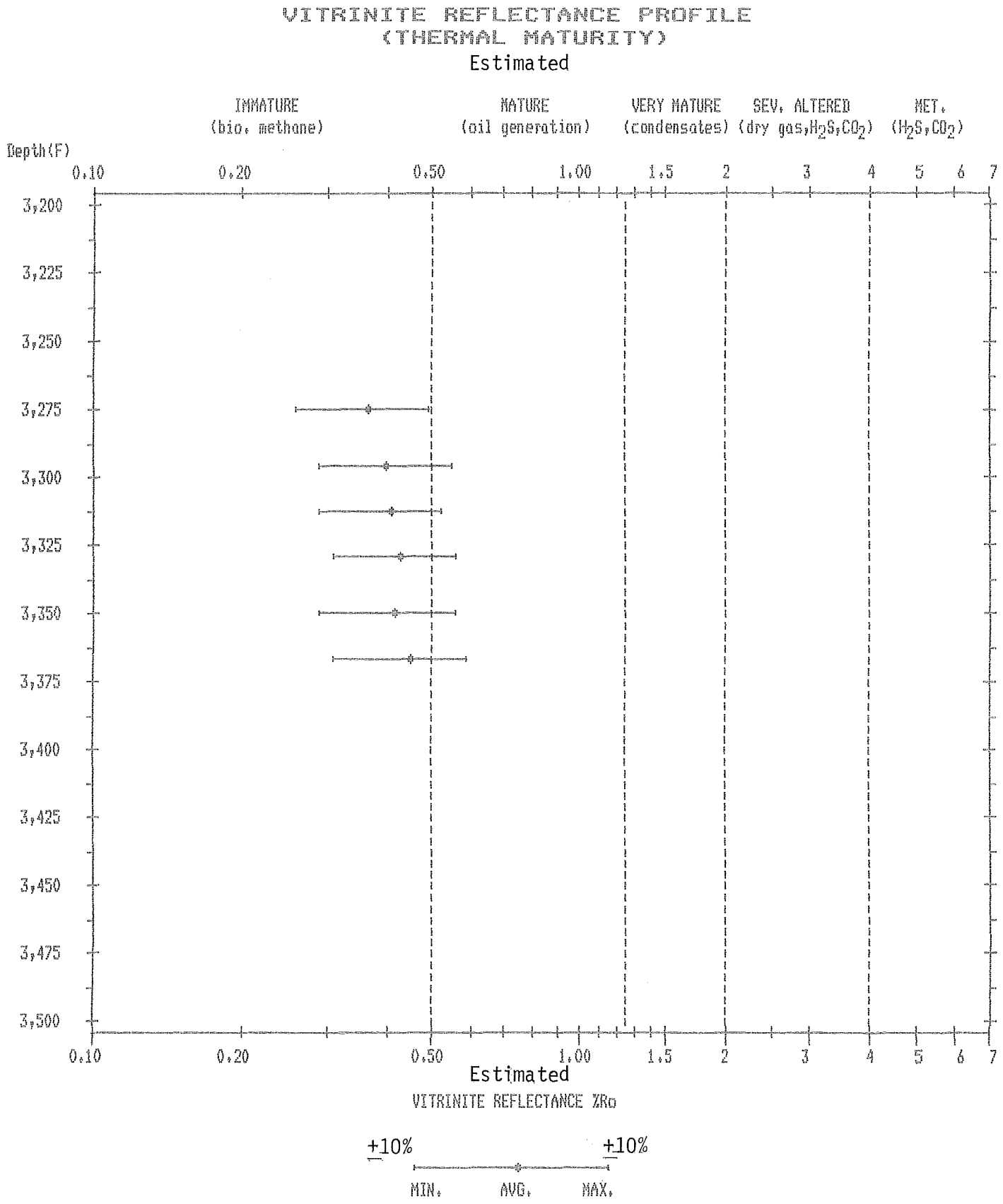
DATA POINTS USED TO CONSTRUCT PROFILE*

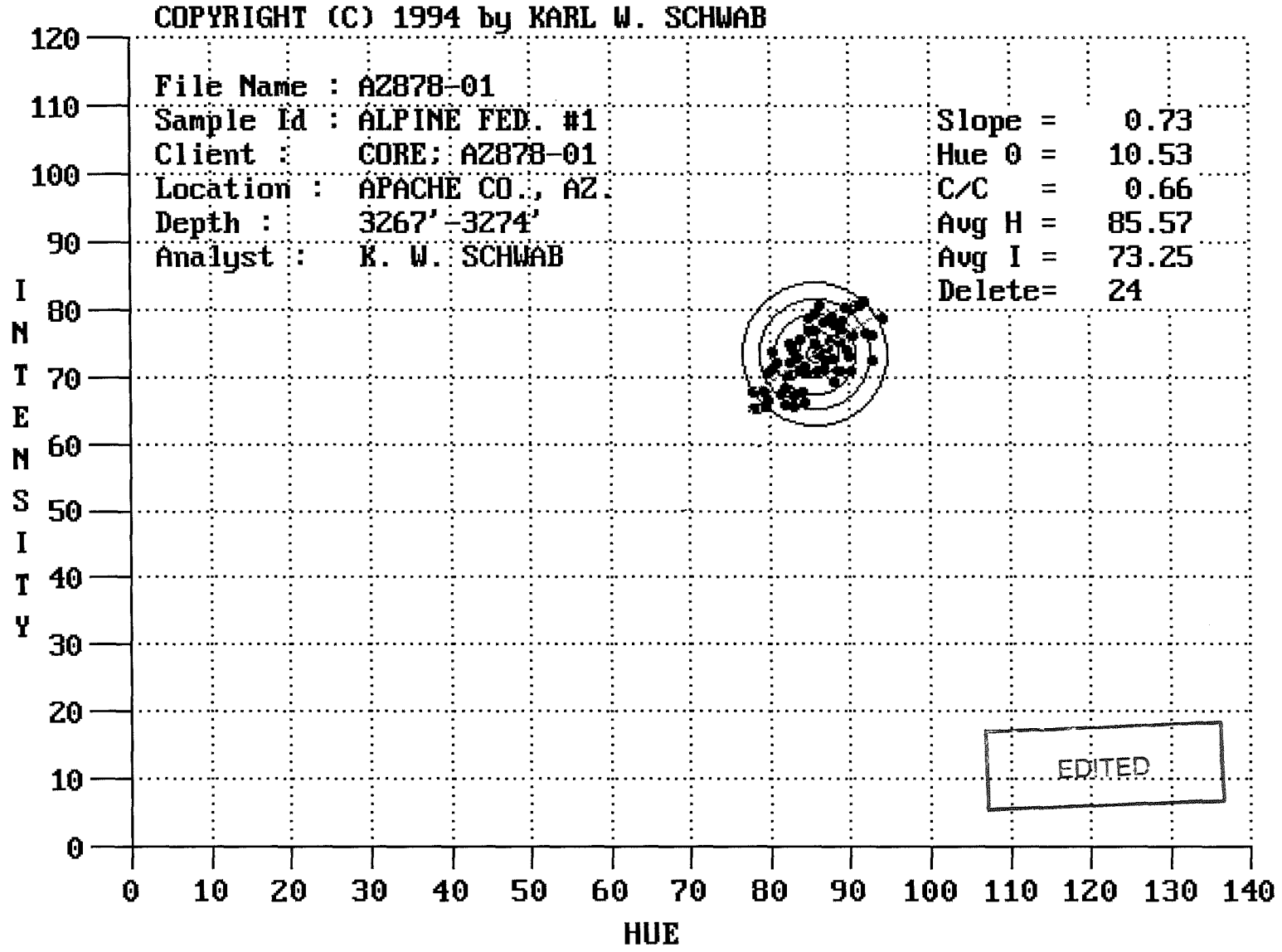
LINE No.	FILE NAME	DEPTH (FEET)	MIN %Ro	MAX %Ro	AVG %Ro	THERMAL MATURITY	LINE NO.	FILE NAME	DEPTH (FEET)	MIN %Ro	MAX %Ro	AVG %Ro	THERMAL MATURITY
1.	AZ878-01	3274	0.26	0.49	0.37	IMMATURE	4.	AZ878-04	3328	0.31	0.56	0.43	IMMATURE
2.	AZ878-02	3294	0.29	0.55	0.40	IMMATURE	5.	AZ878-05	3349	0.29	0.56	0.42	IMMATURE
3.	AZ878-03	3312	0.29	0.52	0.41	IMMATURE	6.	AZ878-06	3365	0.31	0.59	0.45	IMMATURE

*Values considered to be in situ

Edited data from the ICA/SPD Analyses
Values are estimated %Ro

No. 1 Alpine-Federal
(ICA/SPD)




COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-01
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-01
Location : APACHE CO., AZ.
Depth : 3267'-3274'
Analyst : K. W. SCHWAB
Slope = 0.73
Hue 0 = 10.53
C/C = 0.66
Avg H = 85.57
Avg I = 73.25
Delete= 24
EDITED
INTENSITY
HUE
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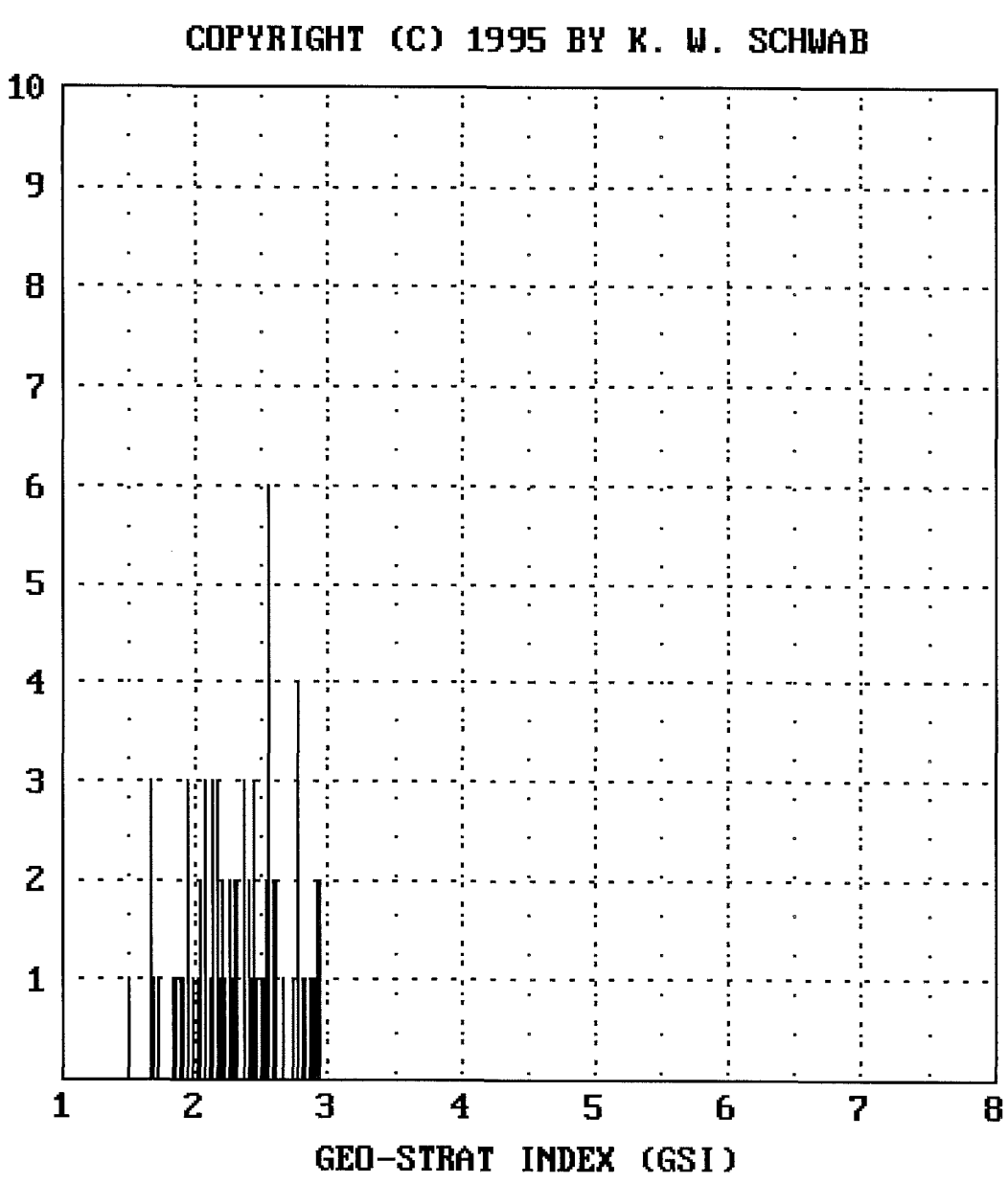
10
20
30
40
50
60
70
80
90
100
110
120
130
140



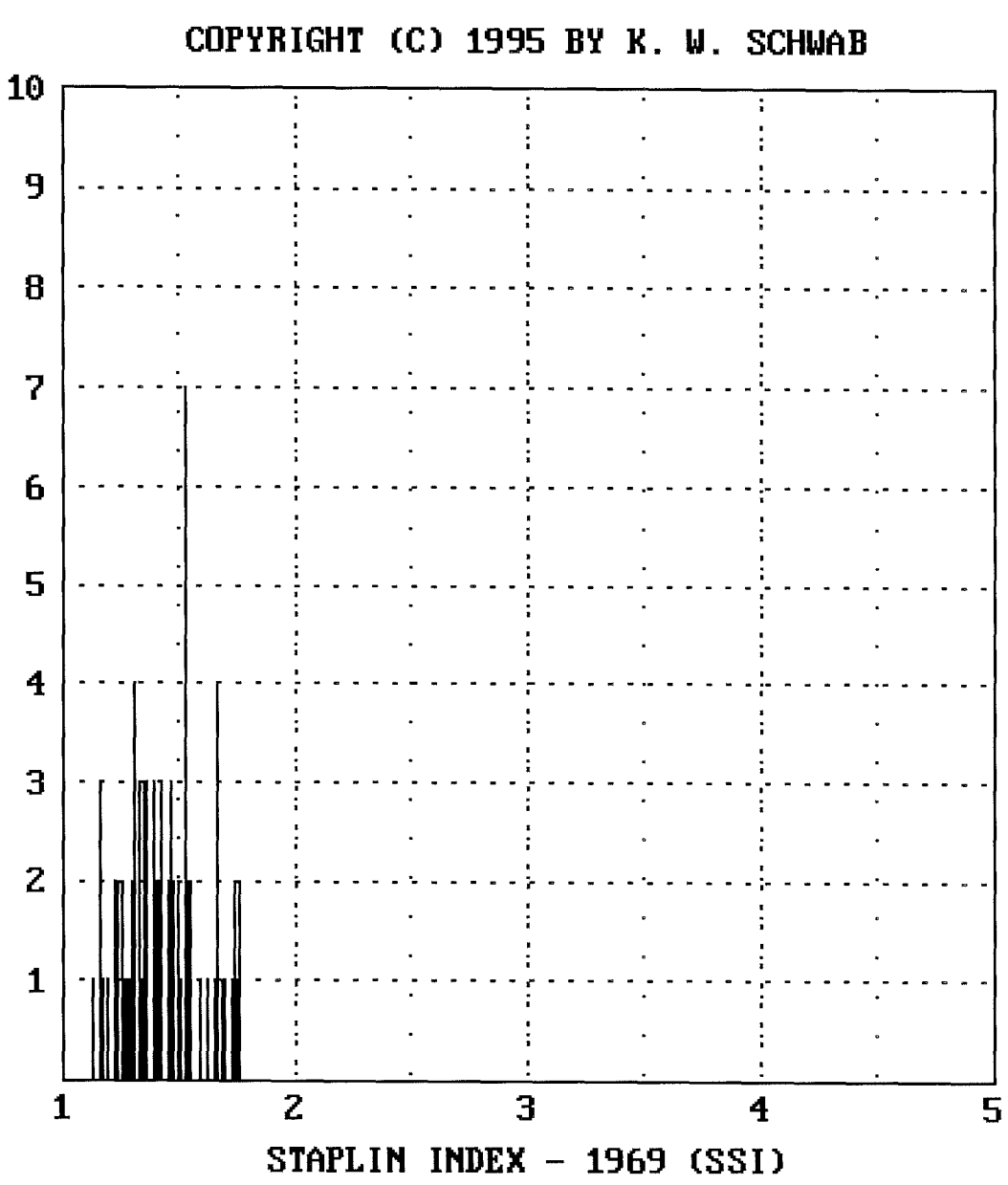
Sample : A2878-01
Depth : 3267'-3274'

Counts = 77

Total Population

Min	Max	Avg	S-D
1.51	2.95	2.33	0.36

EDITED



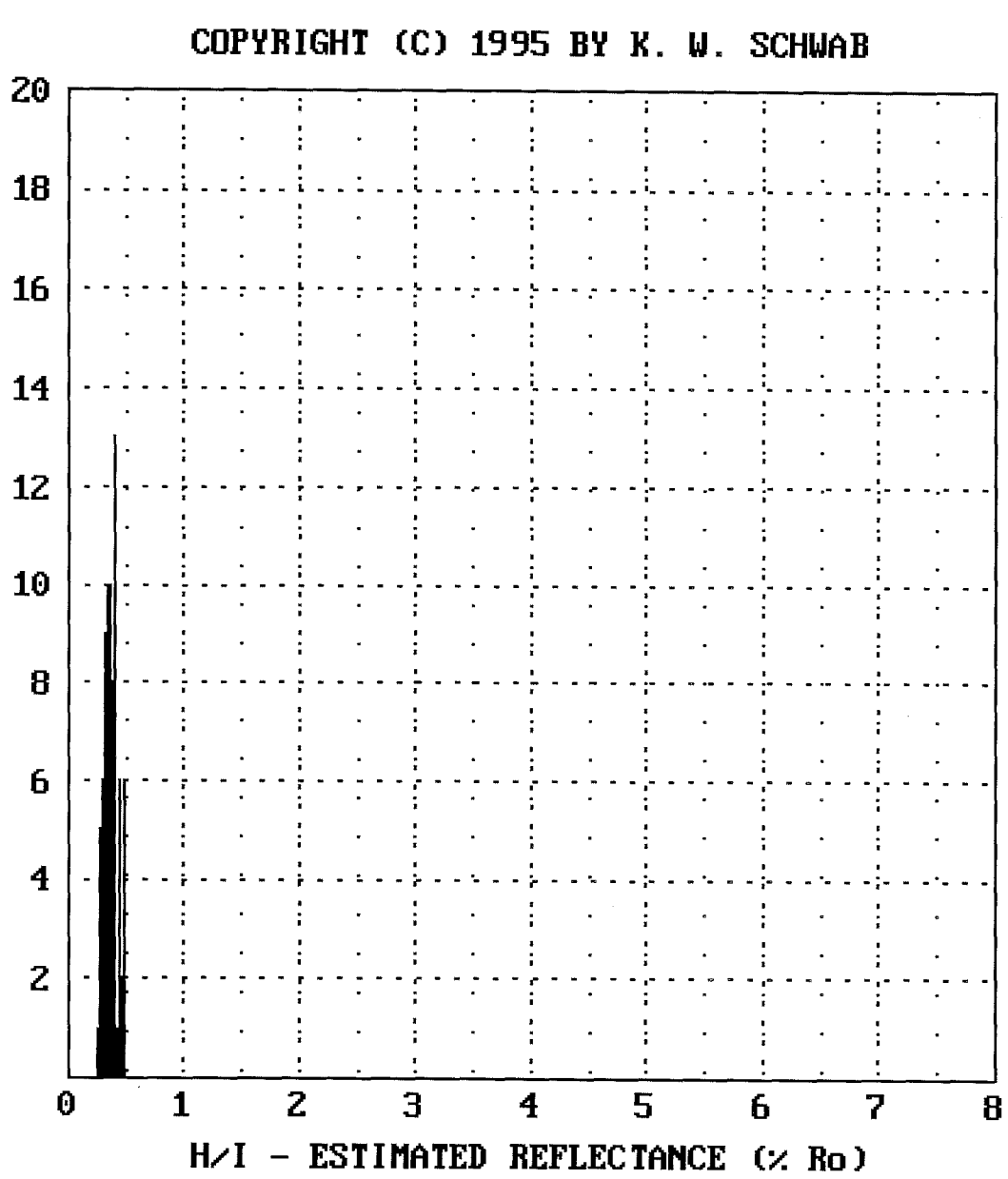
Sample : AZ878-01
Depth : 3267'-3274'

Counts = 77

Total Population

Min	Max	Avg	S-D
1.12	1.76	1.44	0.17

EDITED



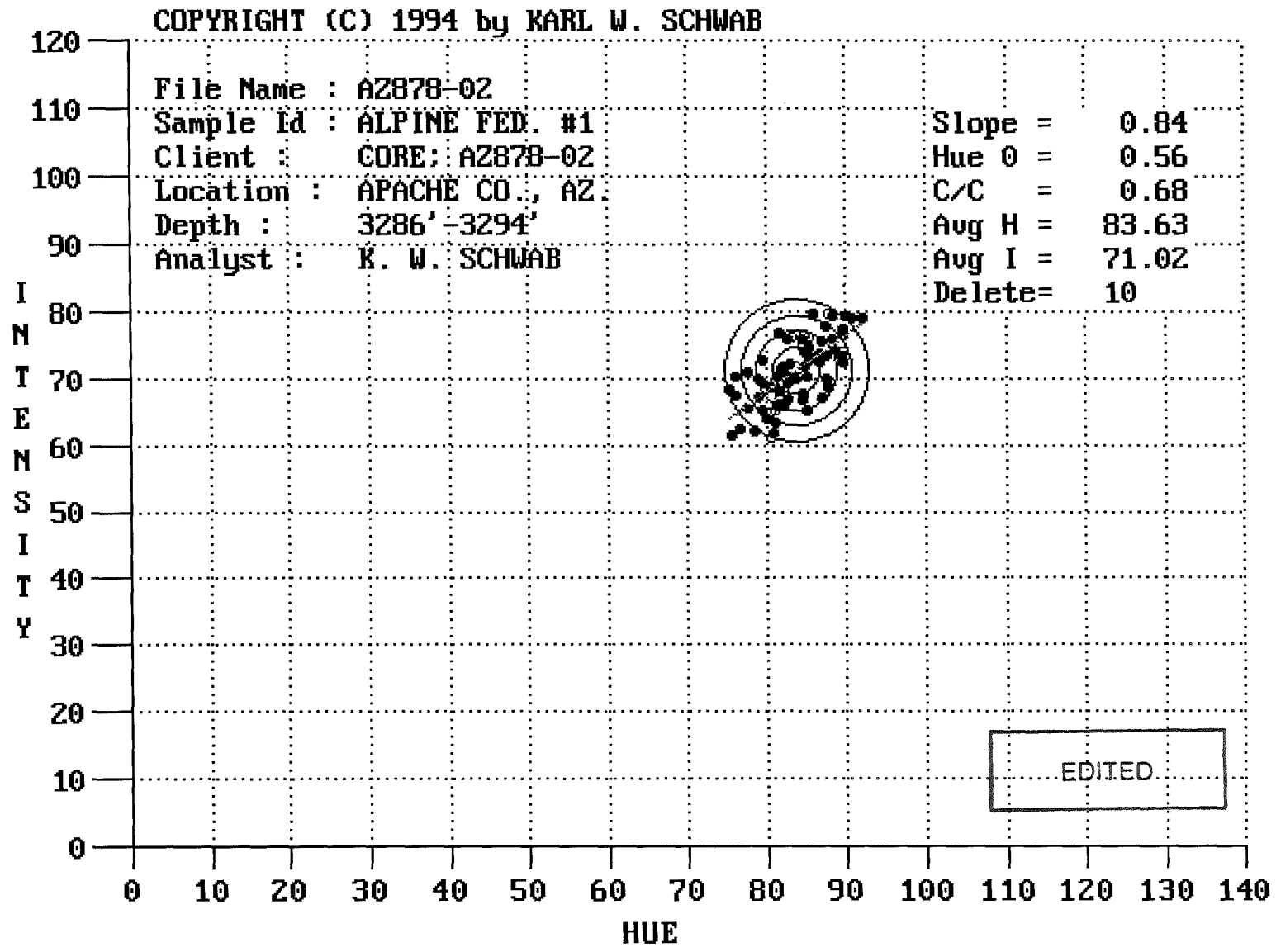
Sample : A2878-01
Depth : 3267'-3274'

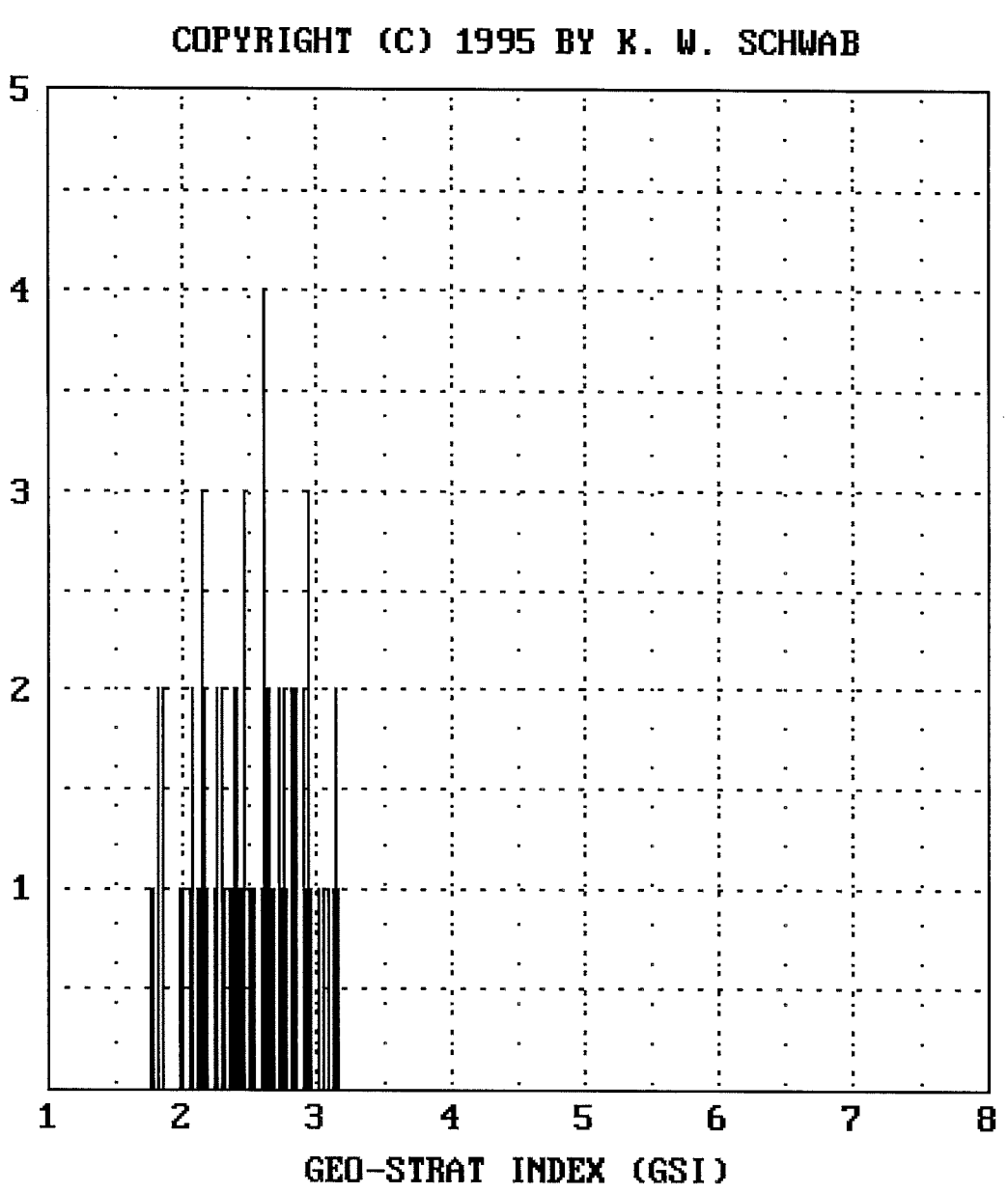
Counts = 77

Total Population

Min	Max	Avg	S-D
0.26	0.49	0.37	0.06

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-02
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-02
Location : APACHE CO., AZ.
Depth : 3286'-3294'
Analyst : K. W. SCHWAB
Slope = 0.84
Hue 0 = 0.56
C/C = 0.68
Avg H = 83.63
Avg I = 71.02
Delete= 10
EDITED
INTENSITY
HUE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140



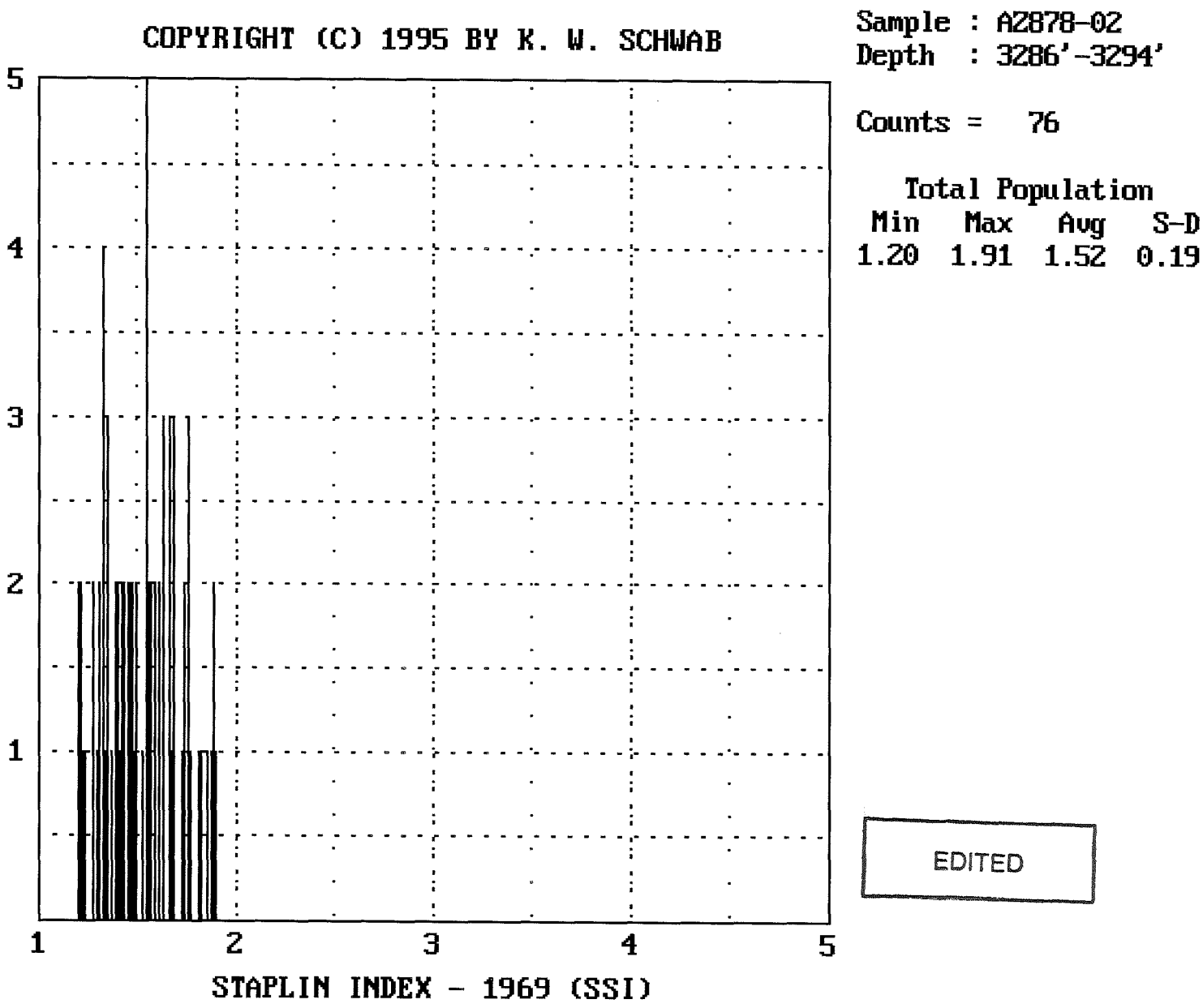
Sample : A2878-02
Depth : 3286'-3294'

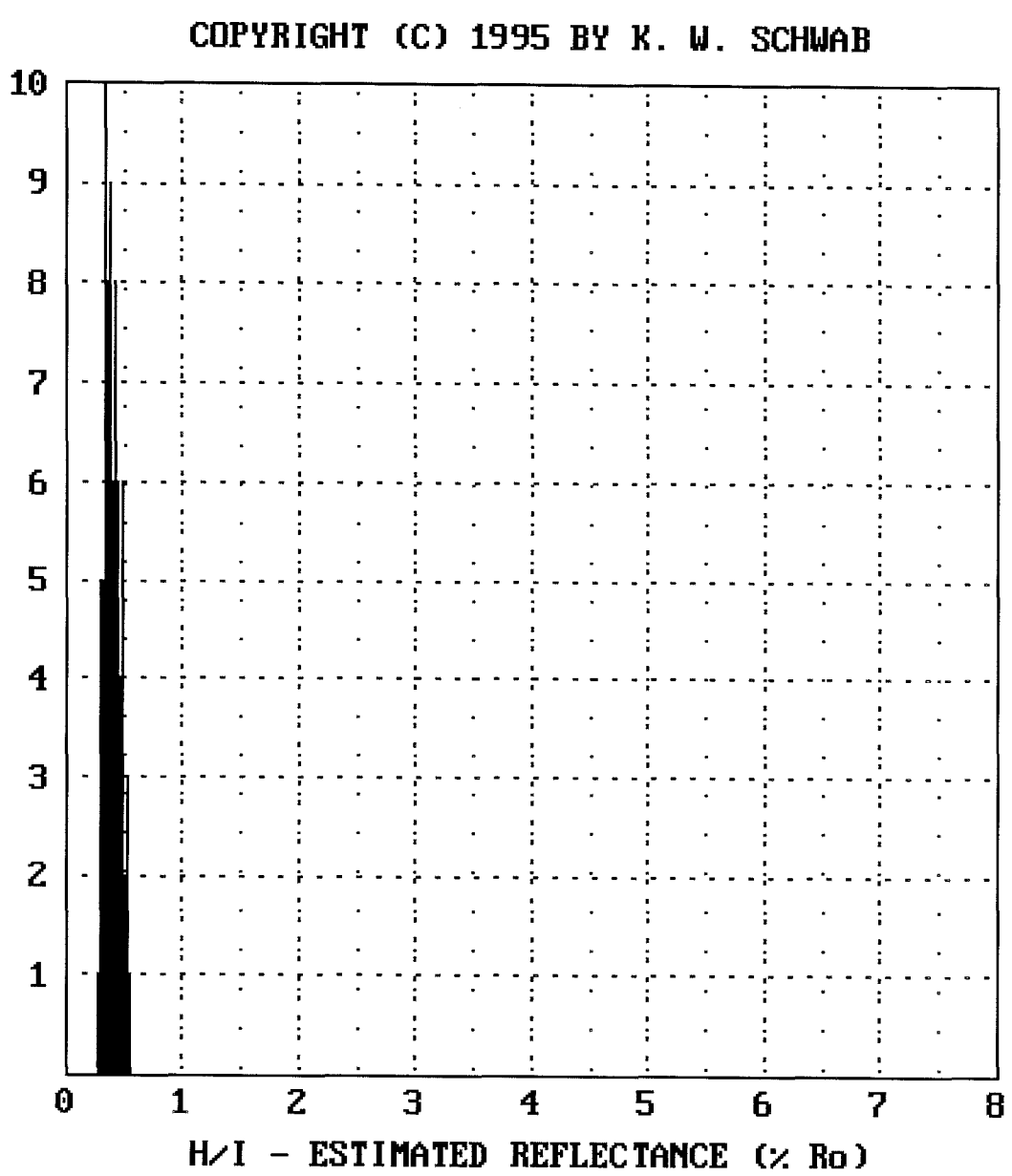
Counts = 76

Total Population

Min	Max	Avg	S-D
1.76	3.16	2.51	0.37

EDITED


COPYRIGHT (C) 1995 BY K. W. SCHWAB
Sample : A2878-02
Depth : 3286'-3294'
Counts = 76
Total Population
Min Max Avg S-D
1.20 1.91 1.52 0.19
EDITED
5
4
3
2
1
1
2
3
4
5
STAPLIN INDEX - 1969 (SSI)



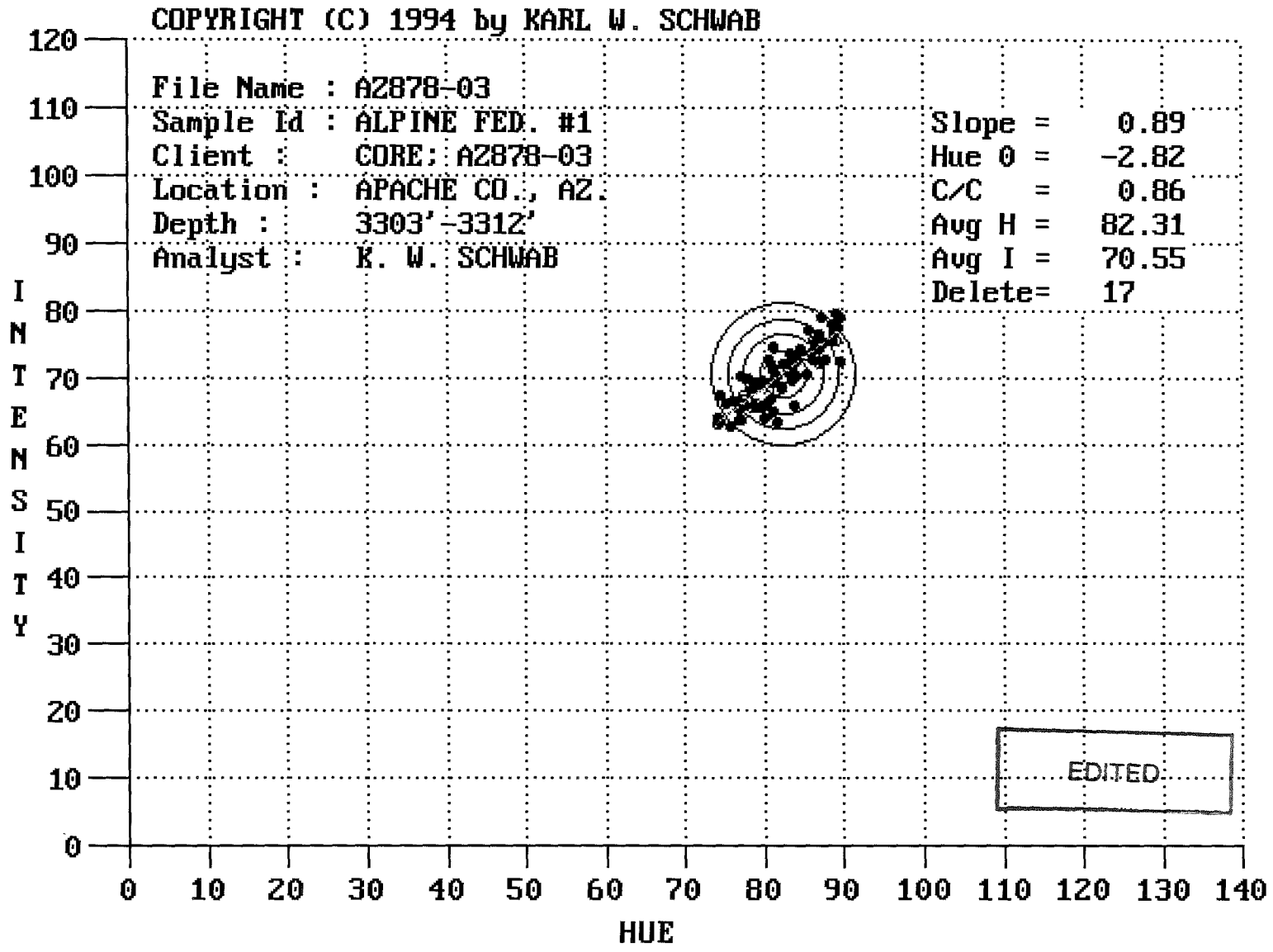
Sample : A2878-02
Depth : 3286'-3294'

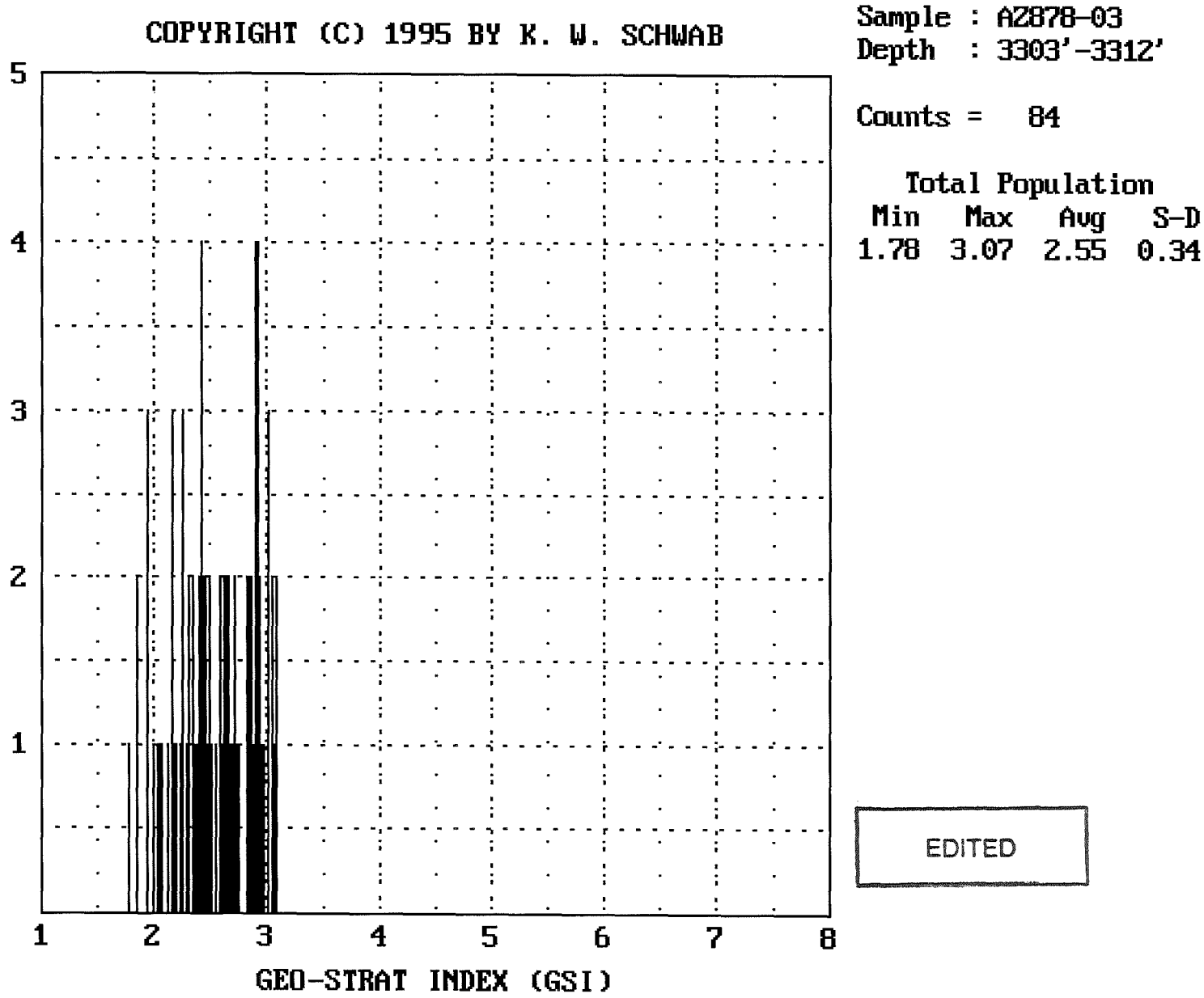
Counts = 76

Total Population

Min	Max	Avg	S-D
0.29	0.55	0.40	0.07

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-03
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-03
Location : APACHE CO., AZ.
Depth : 3303'-3312'
Analyst : K. W. SCHWAB
Slope = 0.89
Hue 0 = -2.82
C/C = 0.86
Avg H = 82.31
Avg I = 70.55
Delete= 17
EDITED
INTENSITY
HUE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140



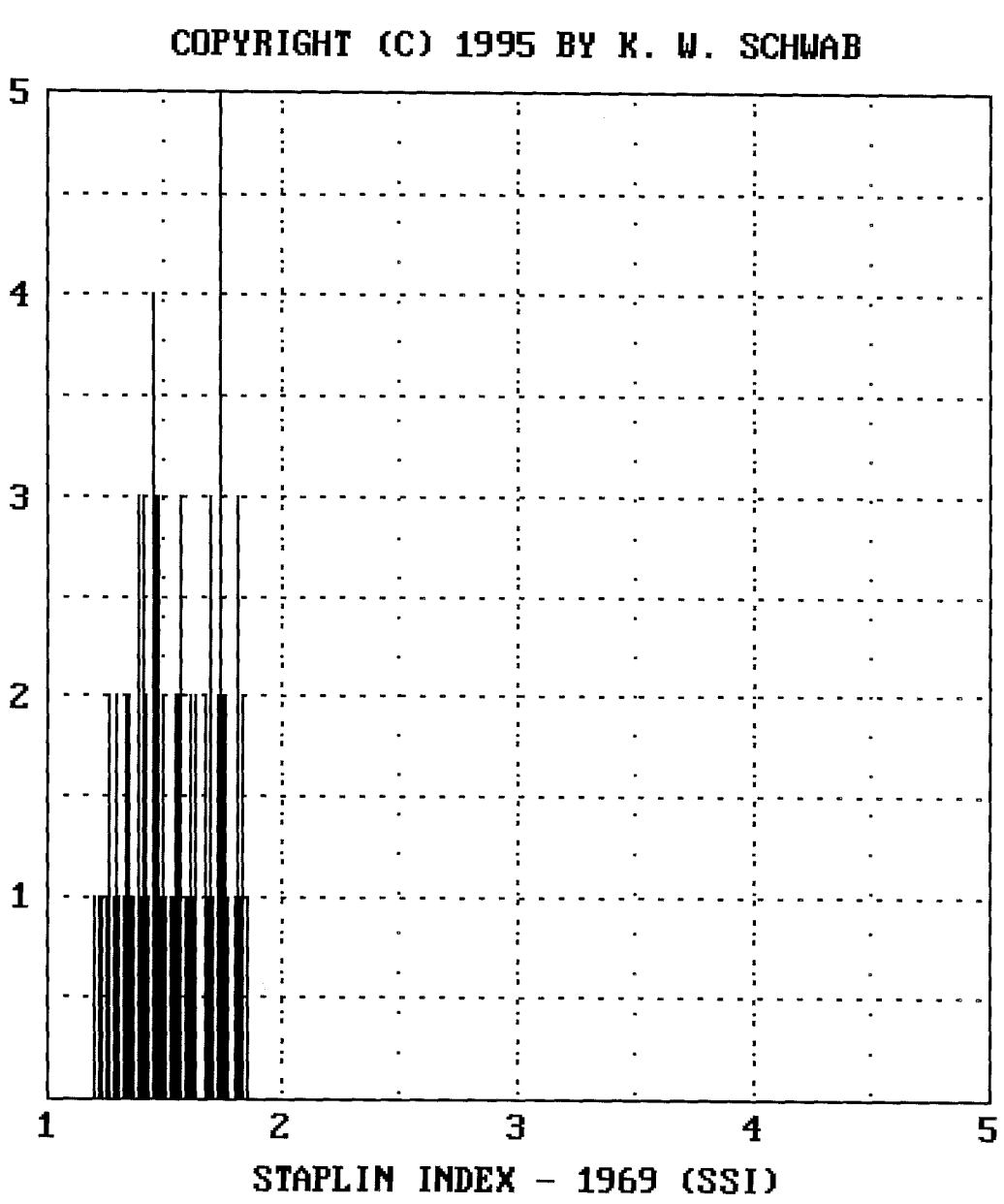
Sample : AZ878-03
Depth : 3303'-3312'

Counts = 84

Total Population

Min	Max	Avg	S-D
1.78	3.07	2.55	0.34

EDITED



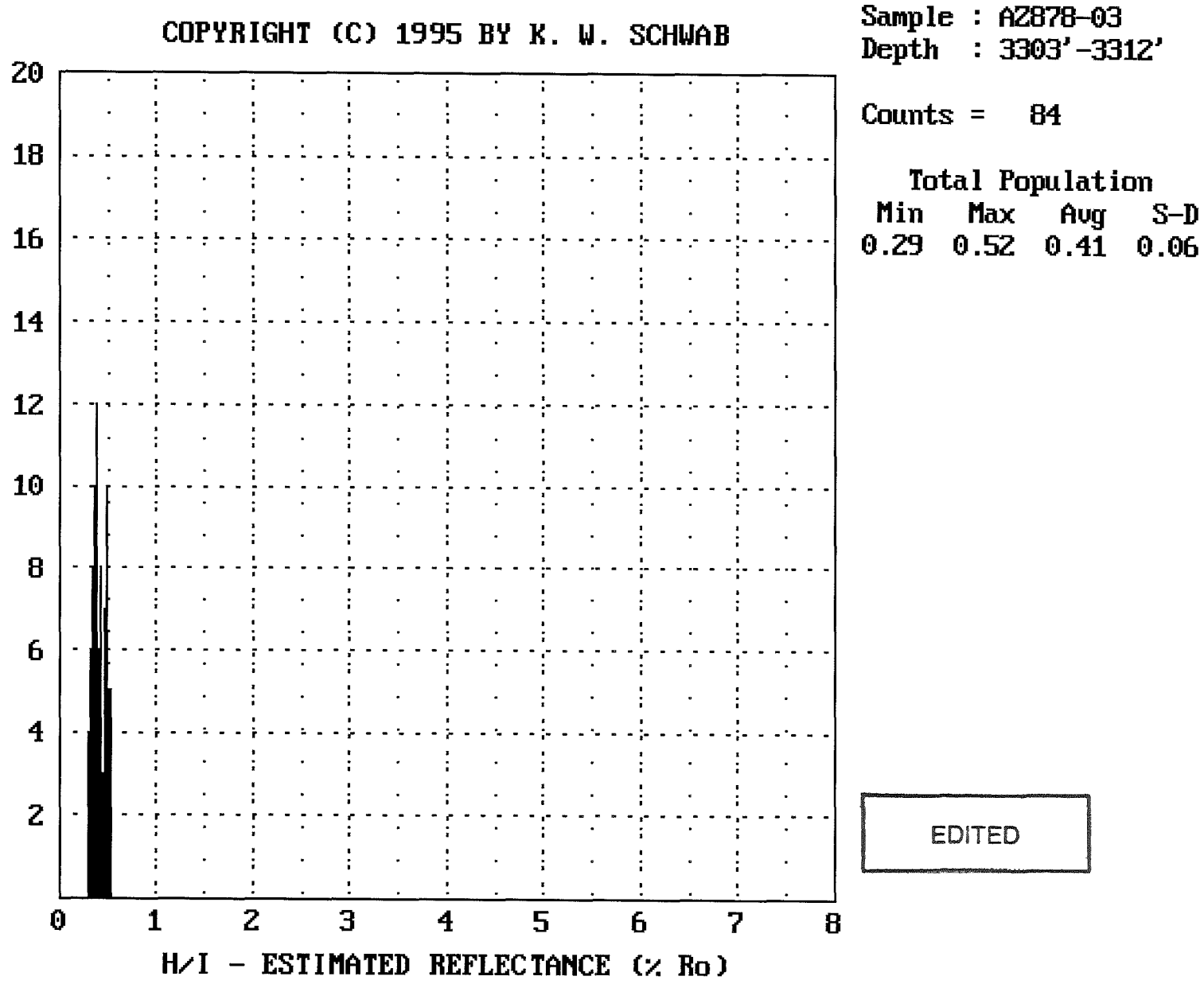
Sample : AZ878-03
Depth : 3303'-3312'

Counts = 84

Total Population

Min	Max	Avg	S-D
1.20	1.85	1.54	0.18

EDITED



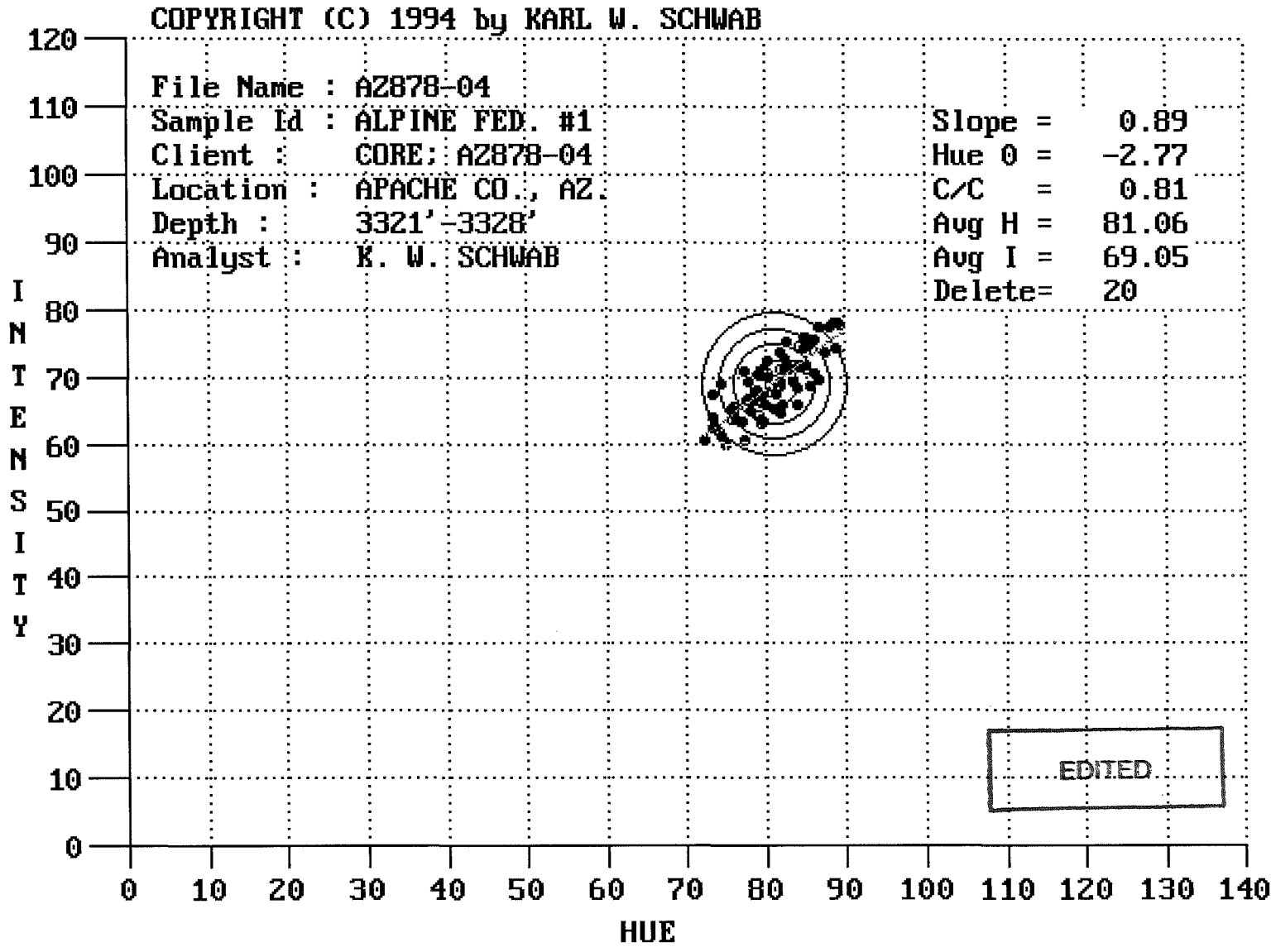
Sample : AZ878-03
Depth : 3303'-3312'

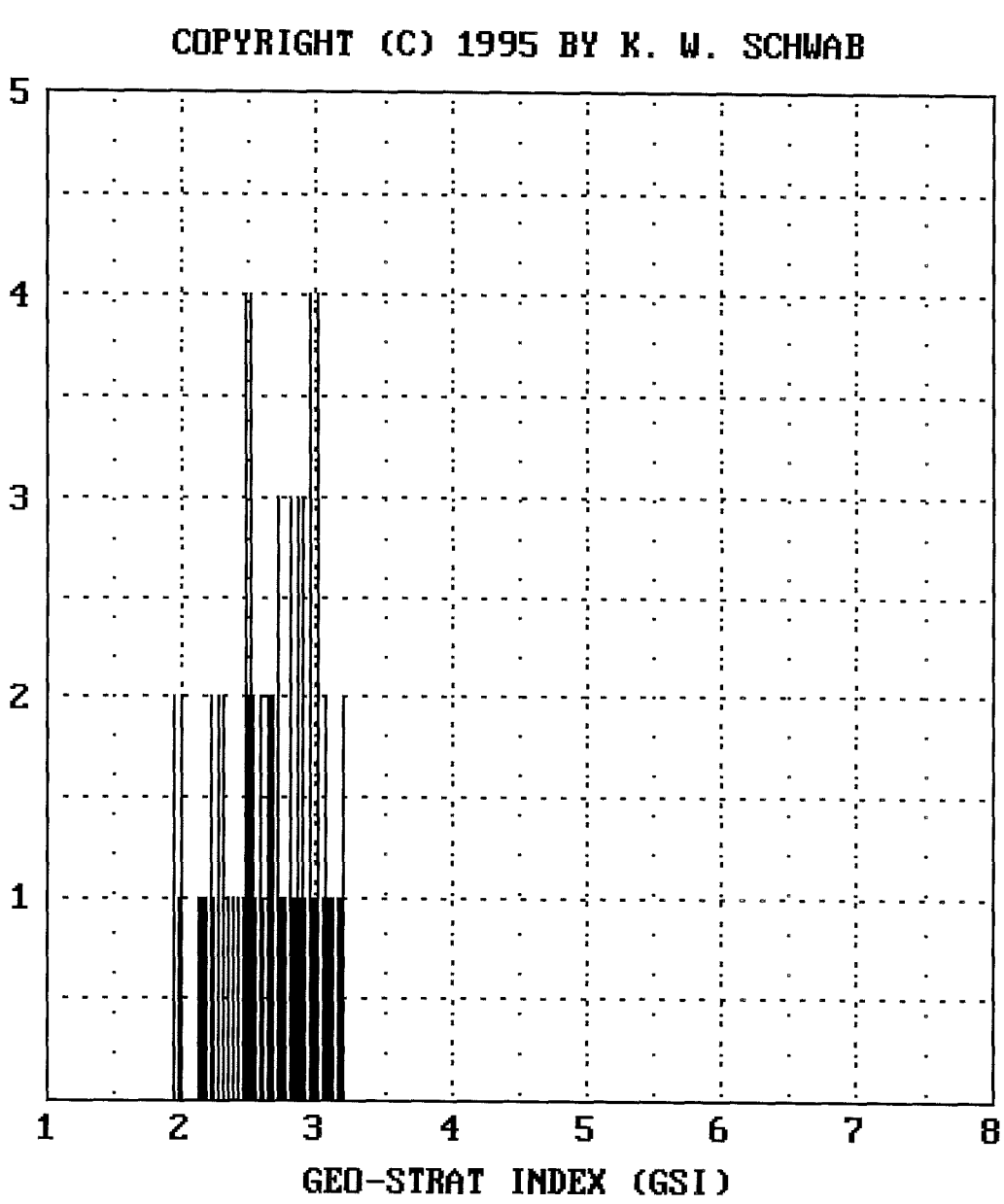
Counts = 84

Total Population

Min	Max	Avg	S-D
0.29	0.52	0.41	0.06

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-04
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-04
Location : APACHE CO., AZ.
Depth : 3321'-3328'
Analyst : K. W. SCHWAB
Slope = 0.89
Hue 0 = -2.77
C/C = 0.81
Avg H = 81.06
Avg I = 69.05
Delete= 20
EDITED
INTENSITY
HUE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140



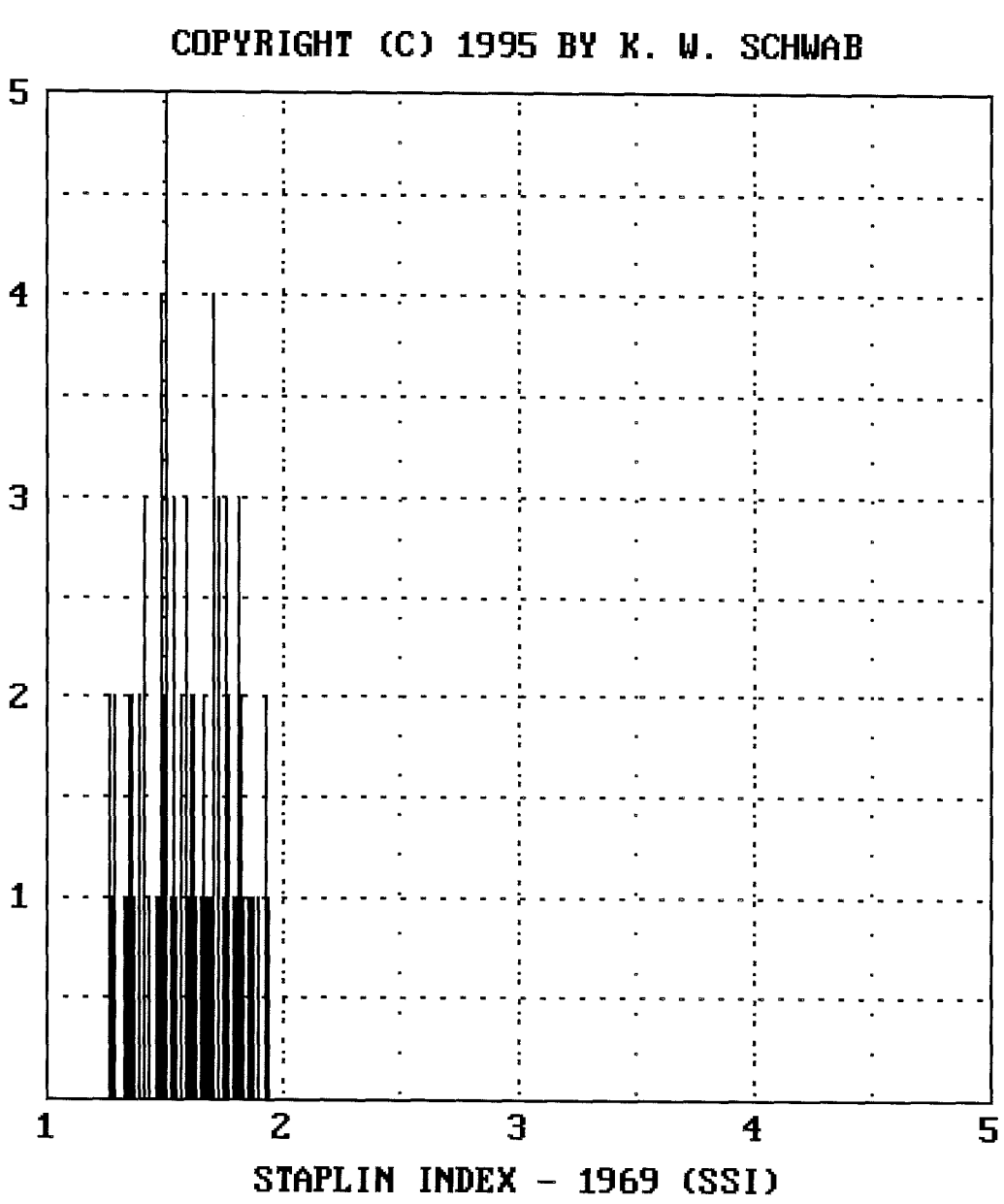
Sample : AZ878-04
Depth : 3321'-3328'

Counts = 81

Total Population

Min	Max	Avg	S-D
1.94	3.21	2.66	0.33

EDITED



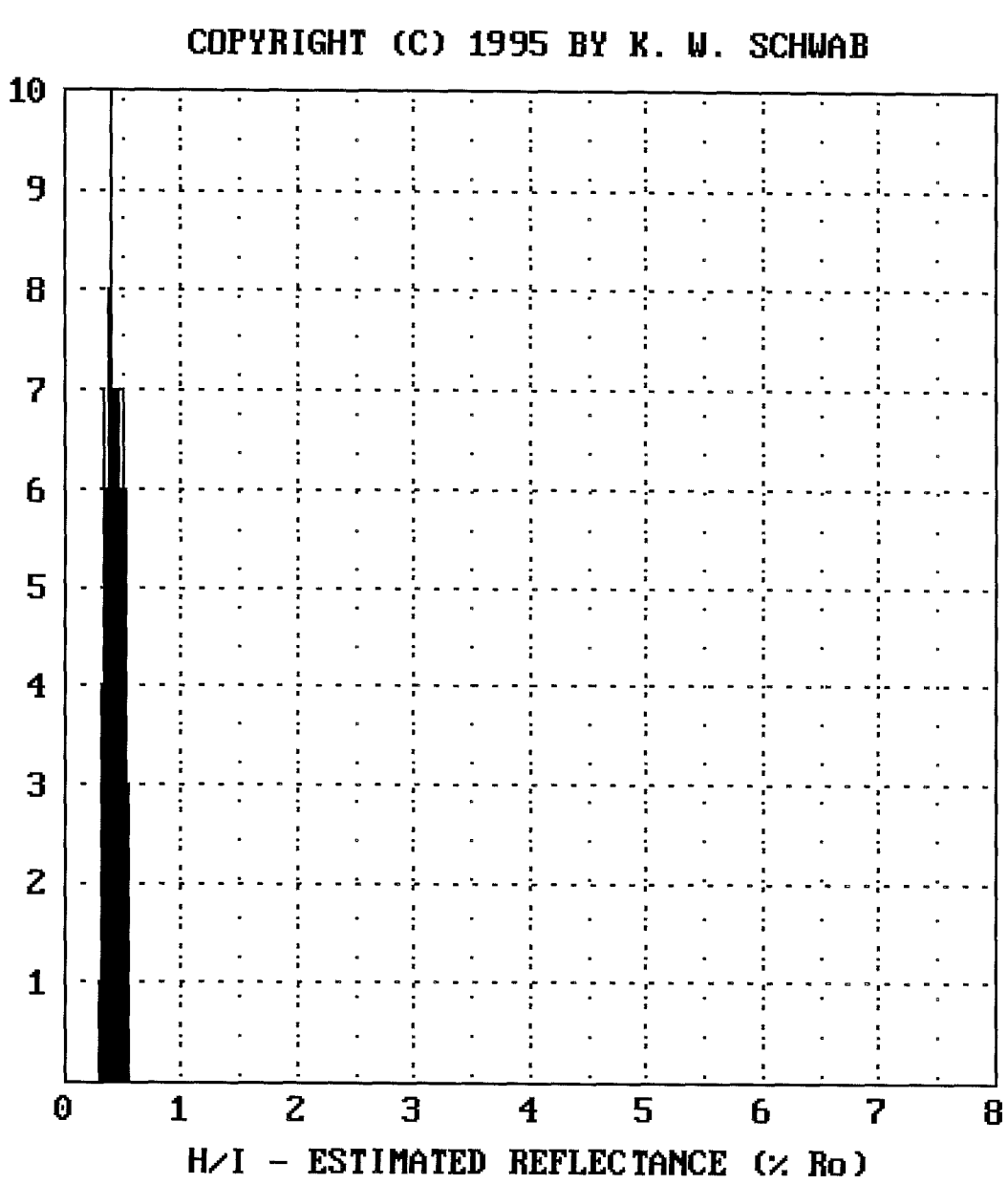
Sample : AZ878-04
Depth : 3321'-3328'

Counts = 81

Total Population

Min	Max	Avg	S-D
1.26	1.94	1.60	0.18

EDITED



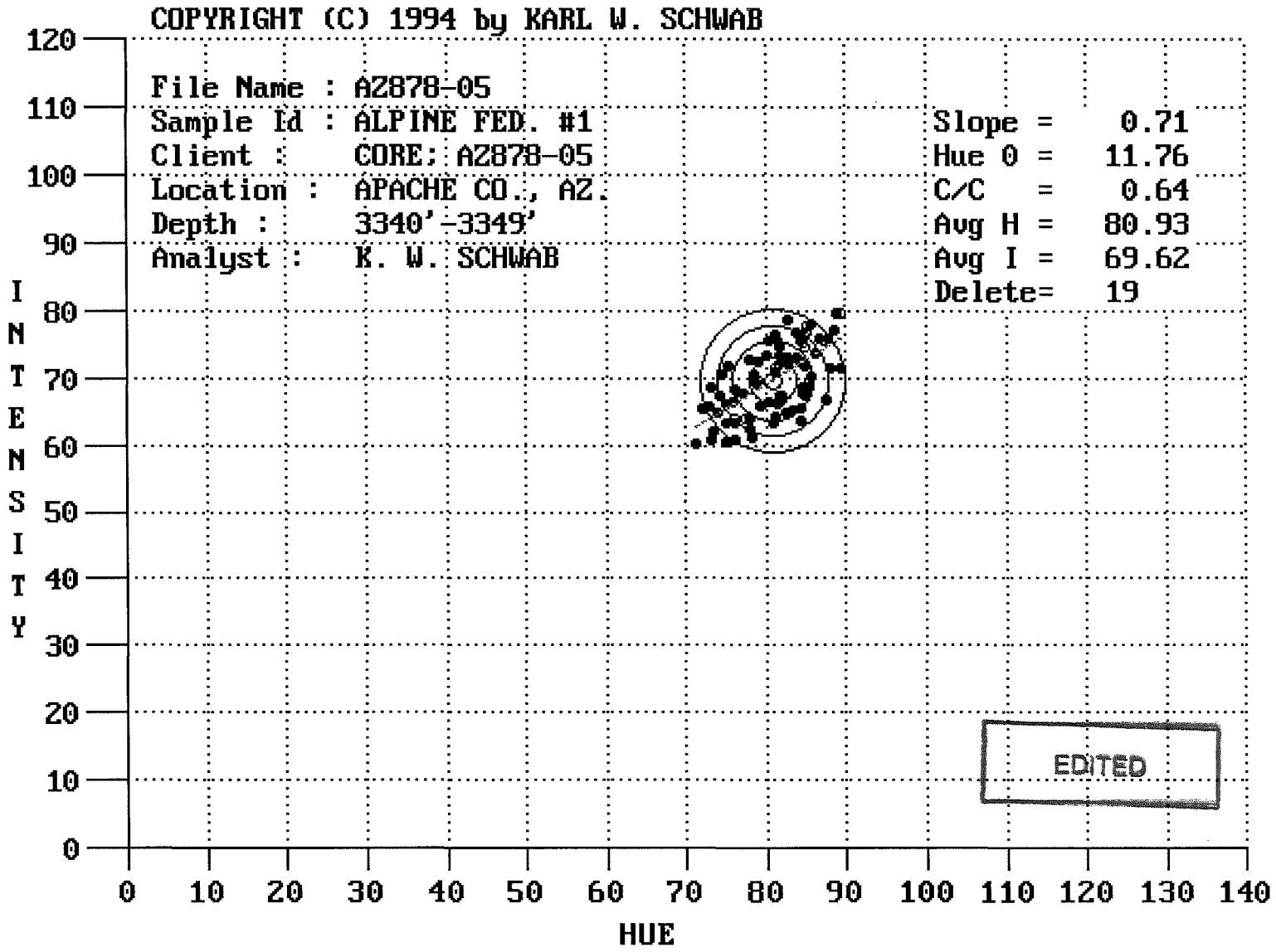
Sample : A2878-04
Depth : 3321'-3328'

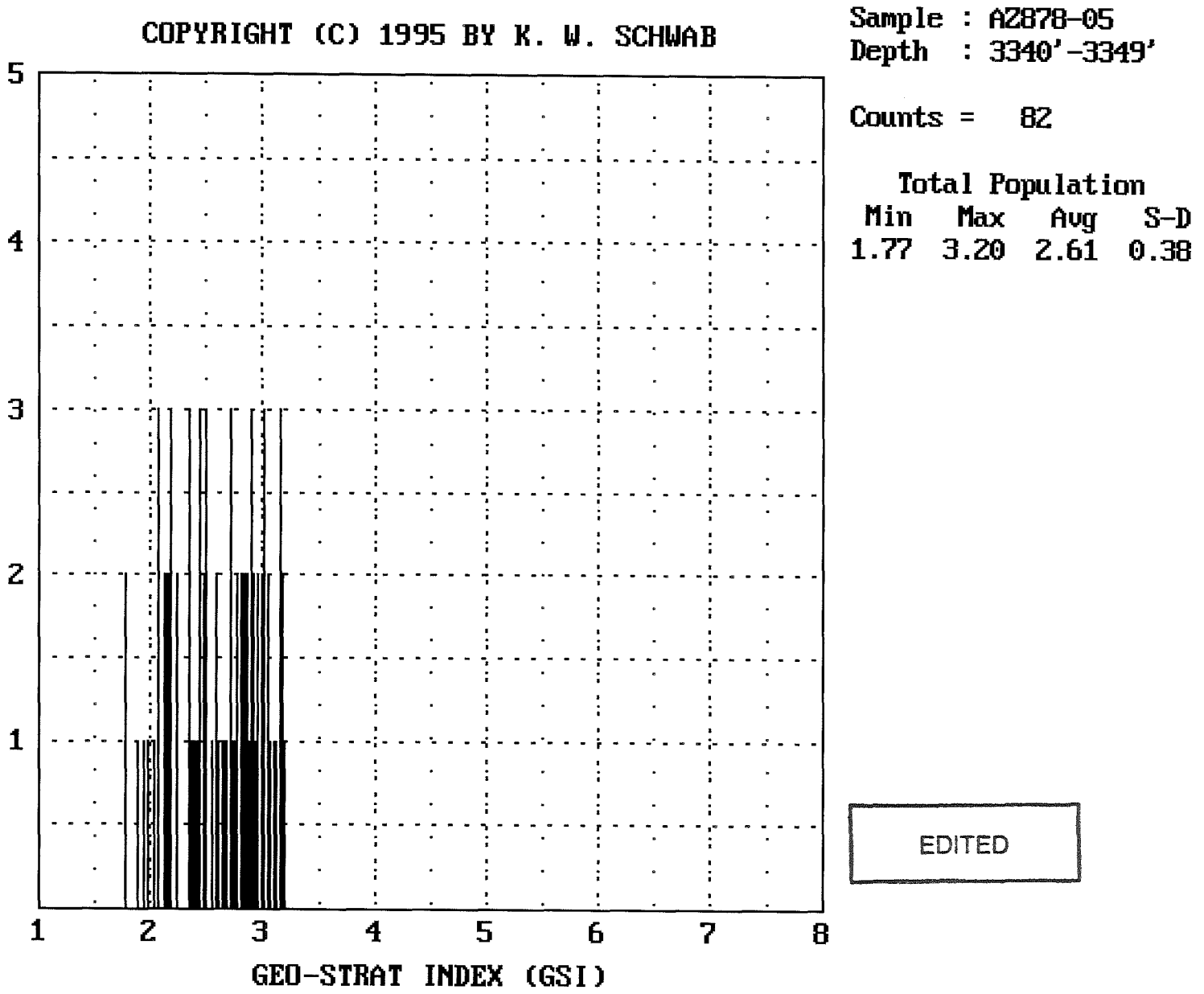
Counts = 81

Total Population

Min	Max	Avg	S-D
0.31	0.56	0.43	0.07

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-05
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-05
Location : APACHE CO., AZ.
Depth : 3340'-3349'
Analyst : K. W. SCHWAB
Slope = 0.71
Hue 0 = 11.76
C/C = 0.64
Avg H = 80.93
Avg I = 69.62
Delete= 19
EDITED
INTENSITY
HUE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140



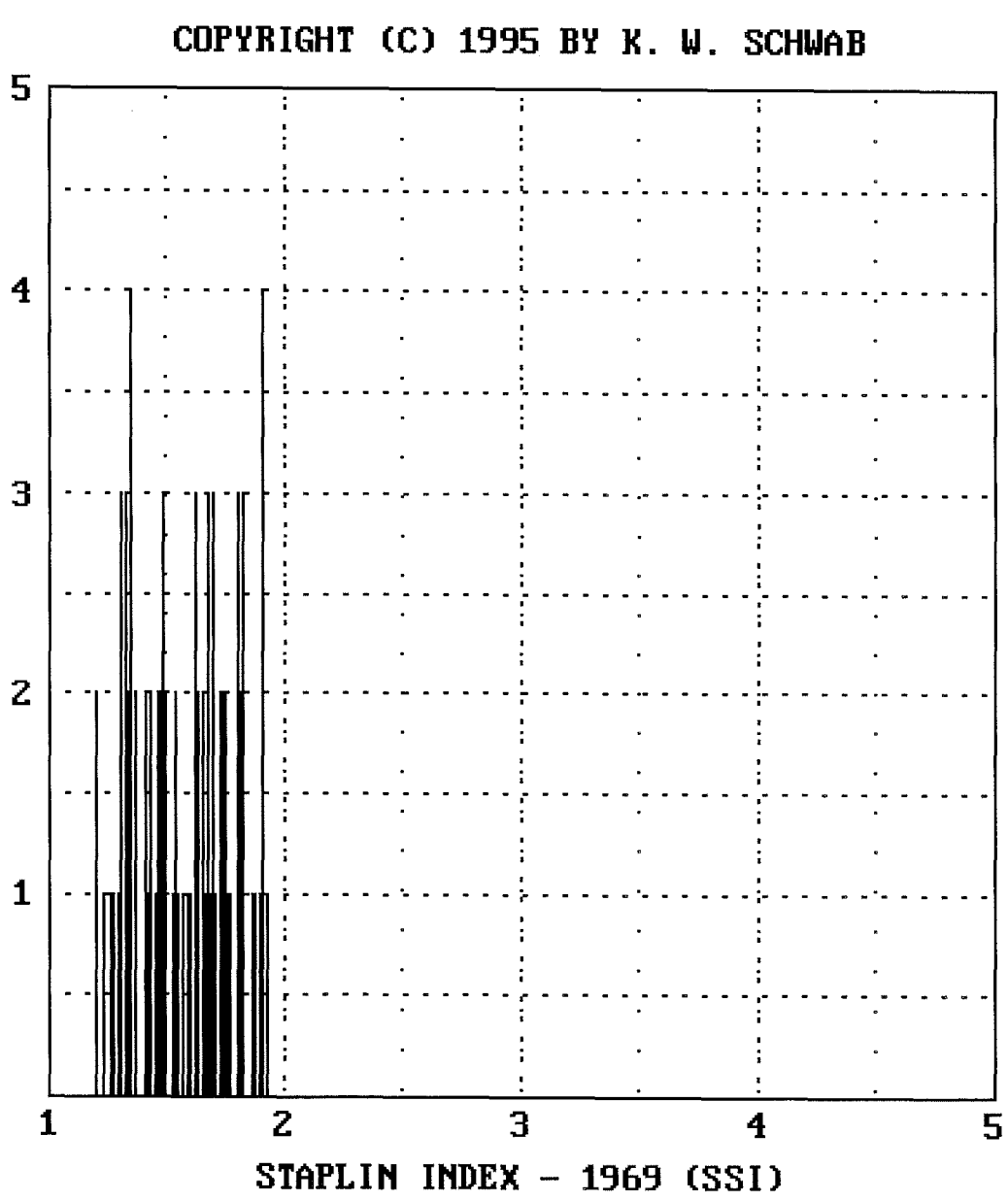
Sample : AZ878-05
Depth : 3340'-3349'

Counts = 82

Total Population

Min	Max	Avg	S-D
1.77	3.20	2.61	0.38

EDITED



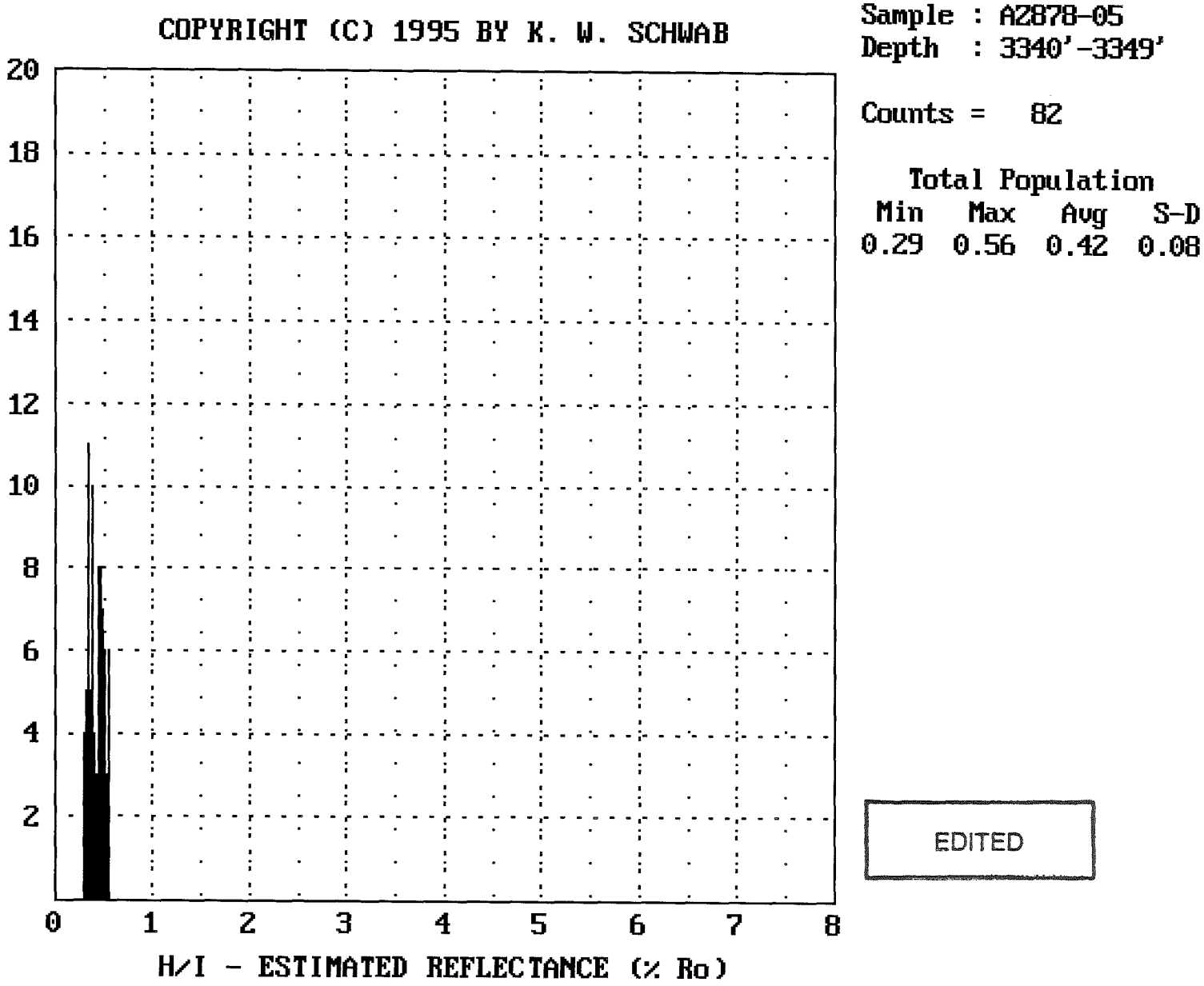
Sample : AZ878-05
Depth : 3340'-3349'

Counts = 82

Total Population

Min	Max	Avg	S-D
1.20	1.93	1.58	0.20

EDITED



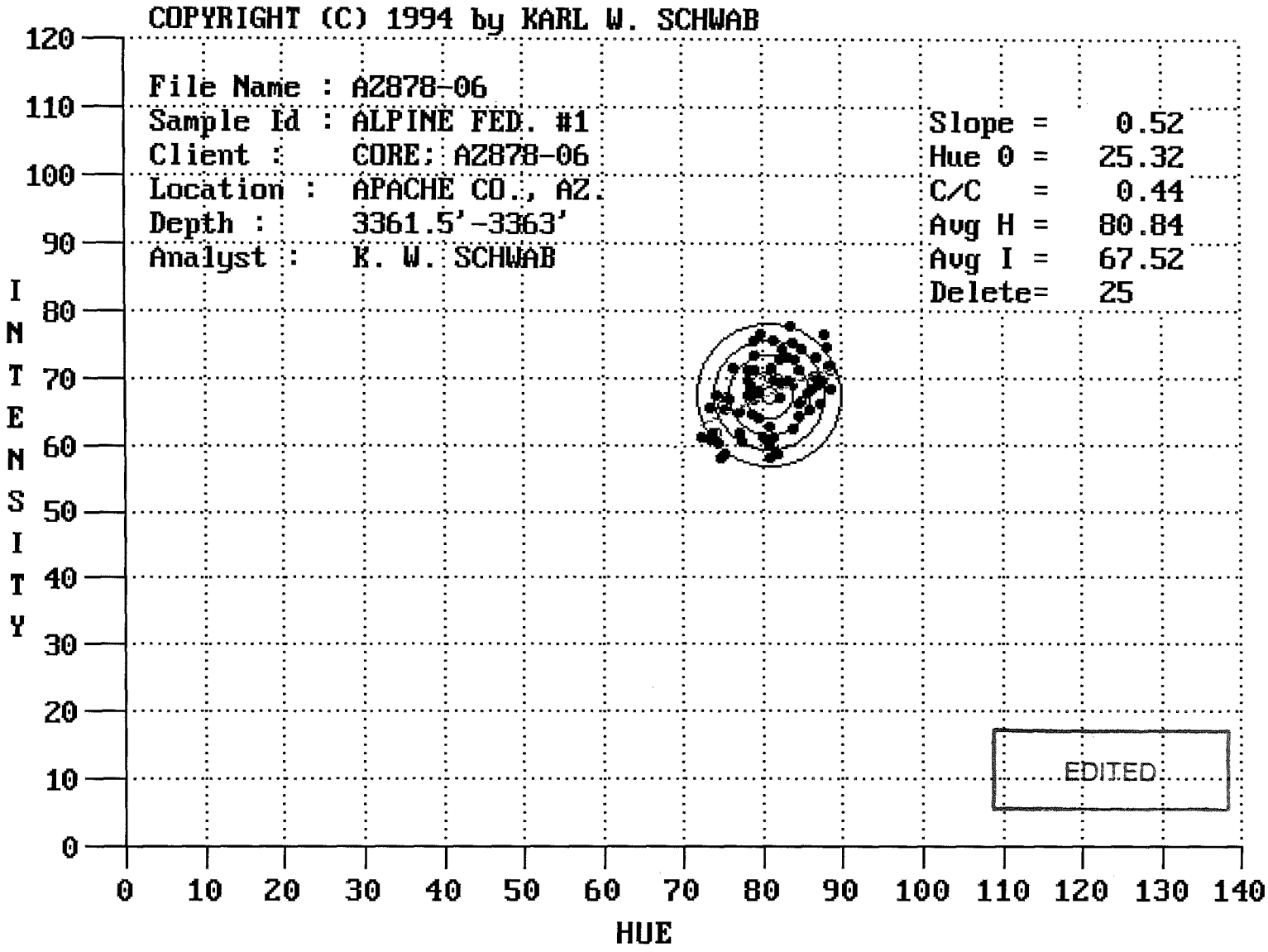
Sample : A2878-05
Depth : 3340'-3349'

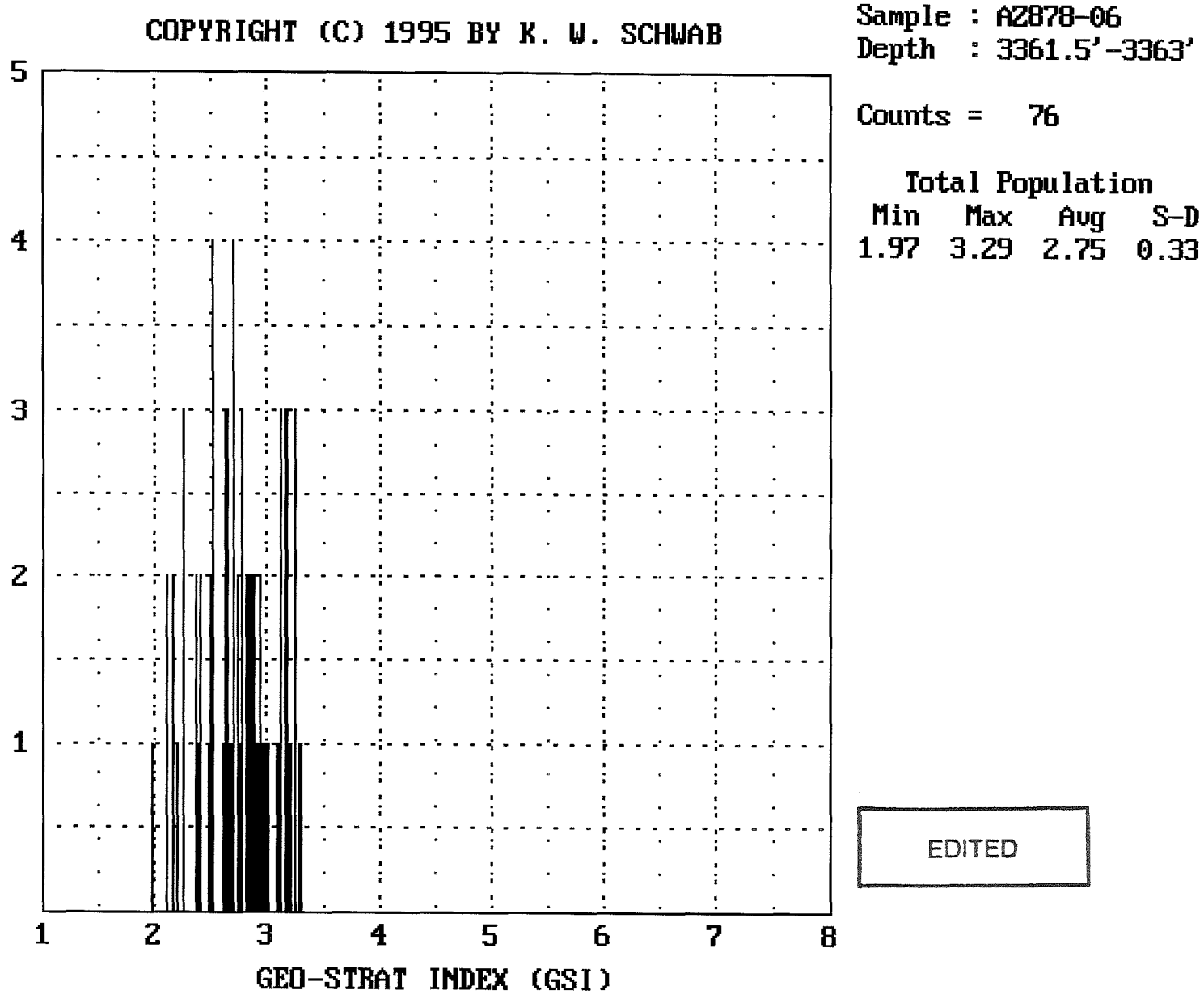
Counts = 82

Total Population

Min	Max	Avg	S-D
0.29	0.56	0.42	0.08

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-06
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-06
Location : APACHE CO., AZ.
Depth : 3361.5'-3363'
Analyst : K. W. SCHWAB
Slope = 0.52
Hue 0 = 25.32
C/C = 0.44
Avg H = 80.84
Avg I = 67.52
Delete= 25
EDITED
INTENSITY
HUE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140



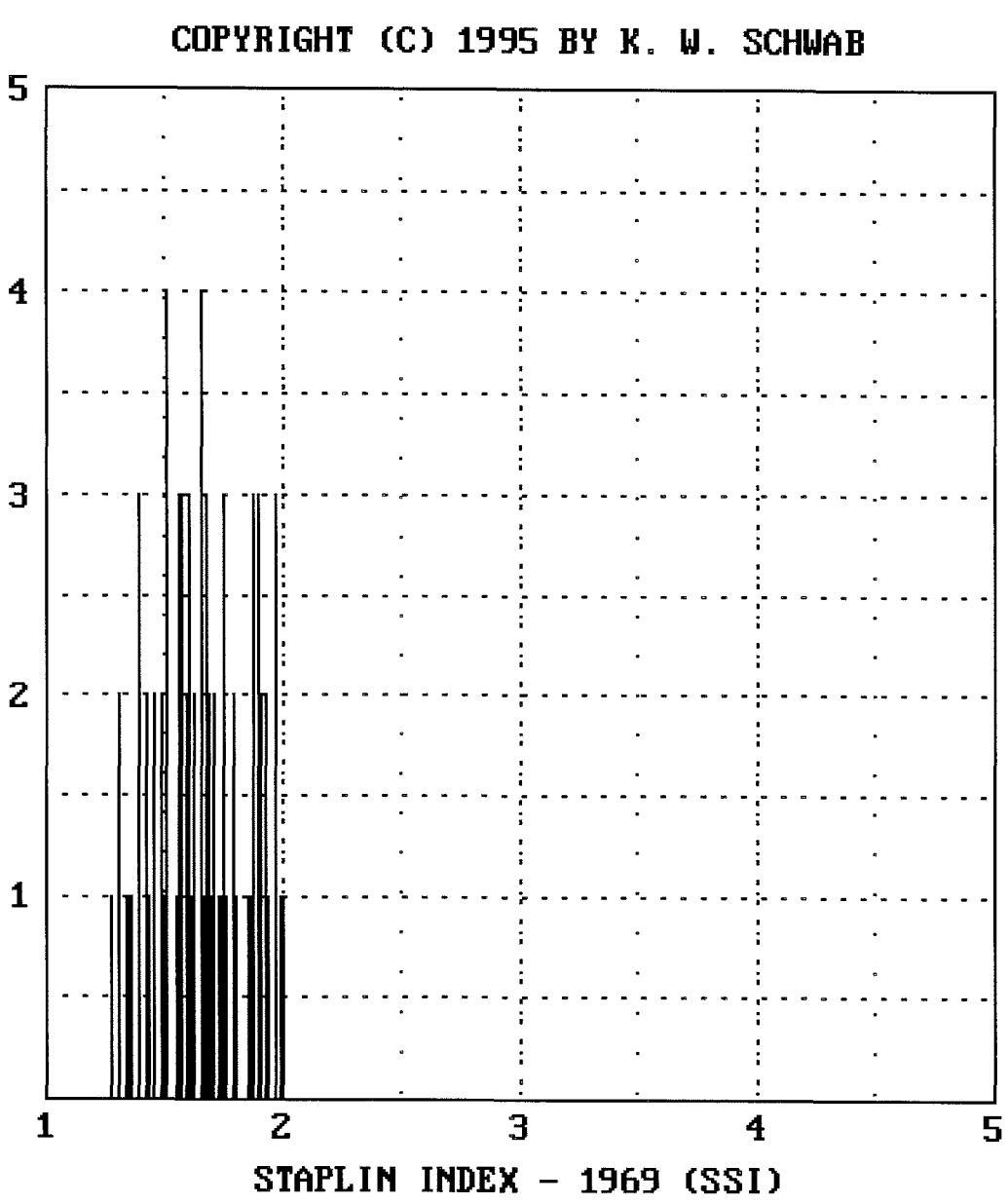
Sample : AZ878-06
Depth : 3361.5'-3363'

Counts = 76

Total Population

Min	Max	Avg	S-D
1.97	3.29	2.75	0.33

EDITED



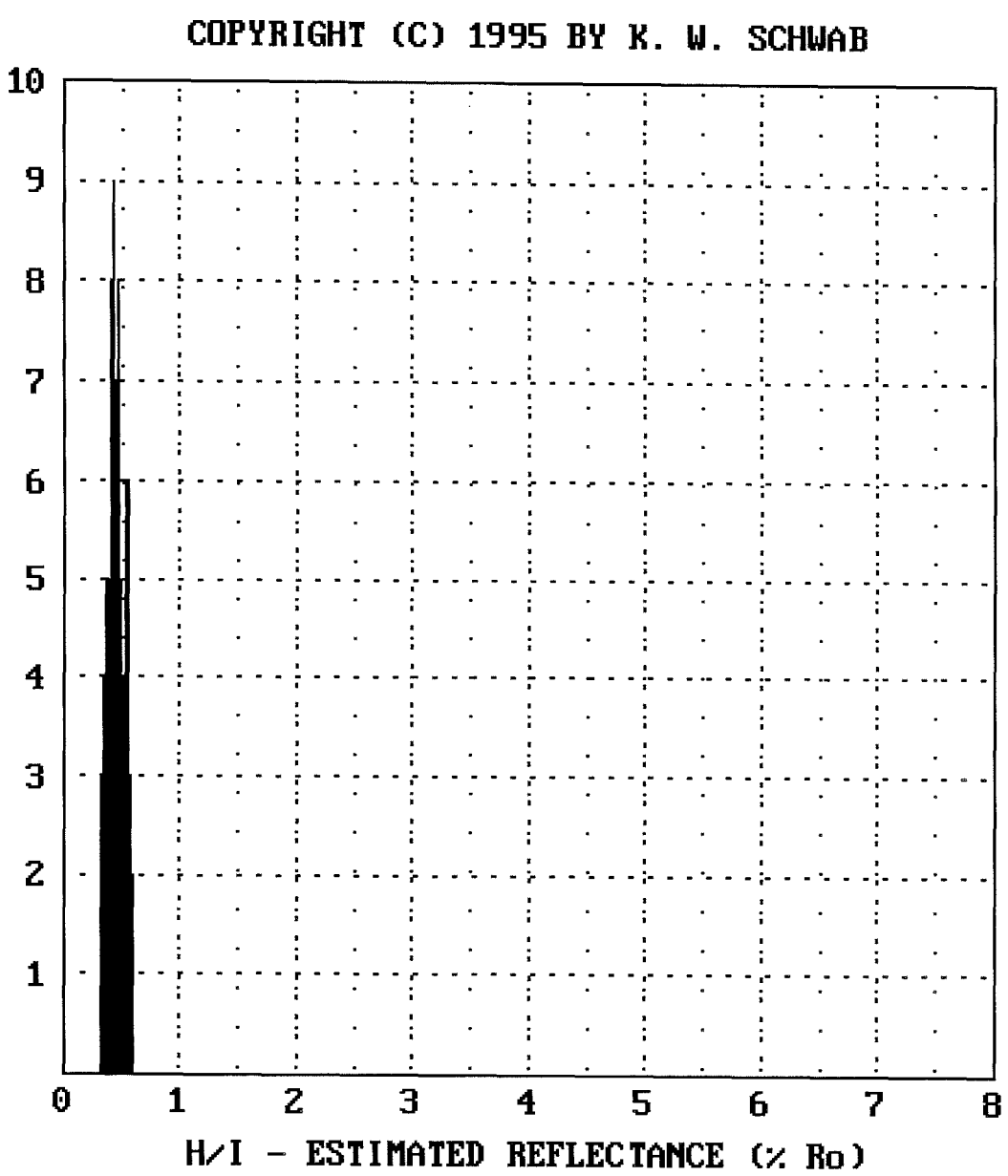
Sample : AZ878-06
Depth : 3361.5'-3363'

Counts = 76

Total Population

Min	Max	Avg	S-D
1.27	2.00	1.66	0.19

EDITED



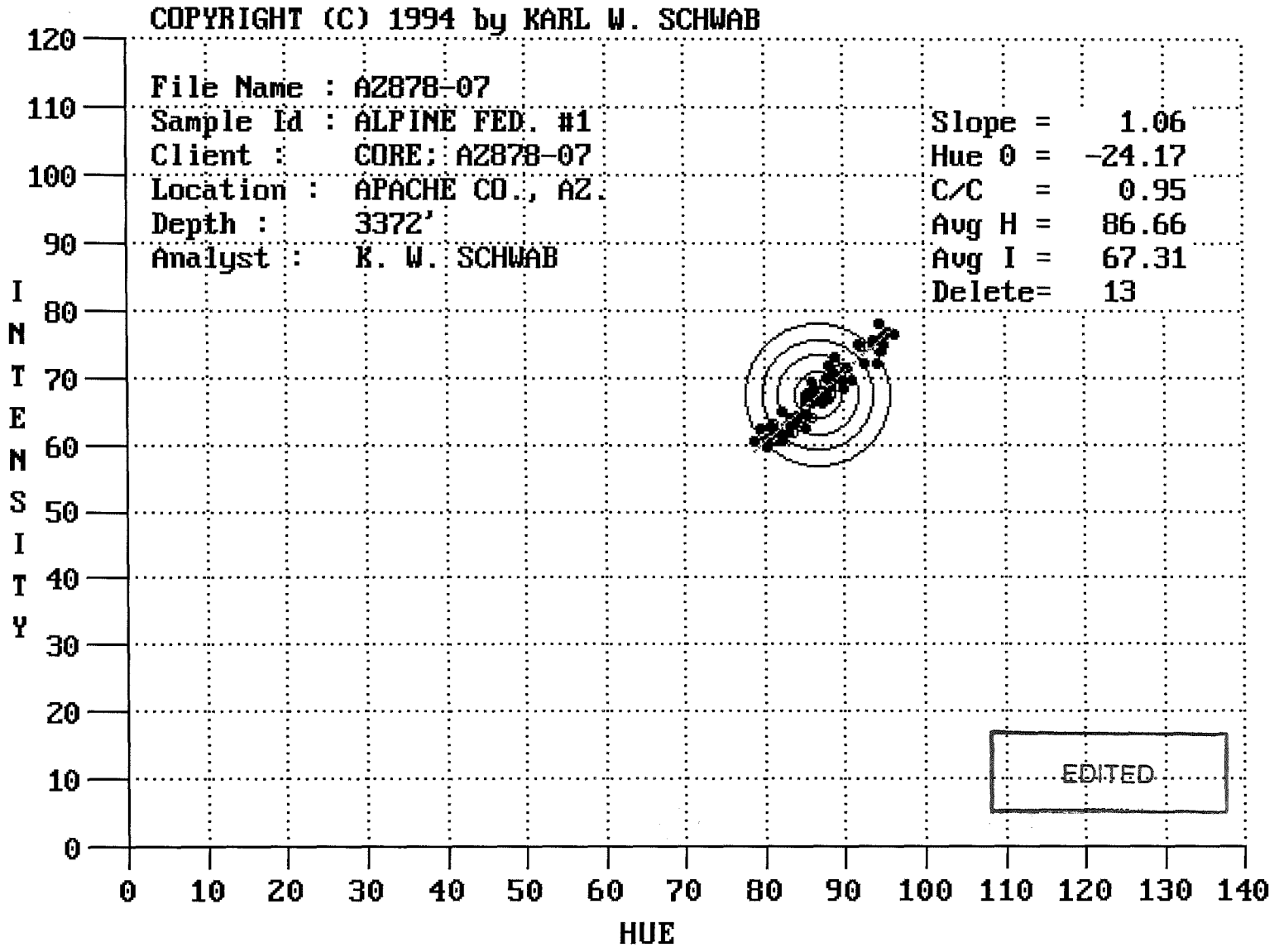
Sample : AZ878-06
Depth : 3361.5'-3363'

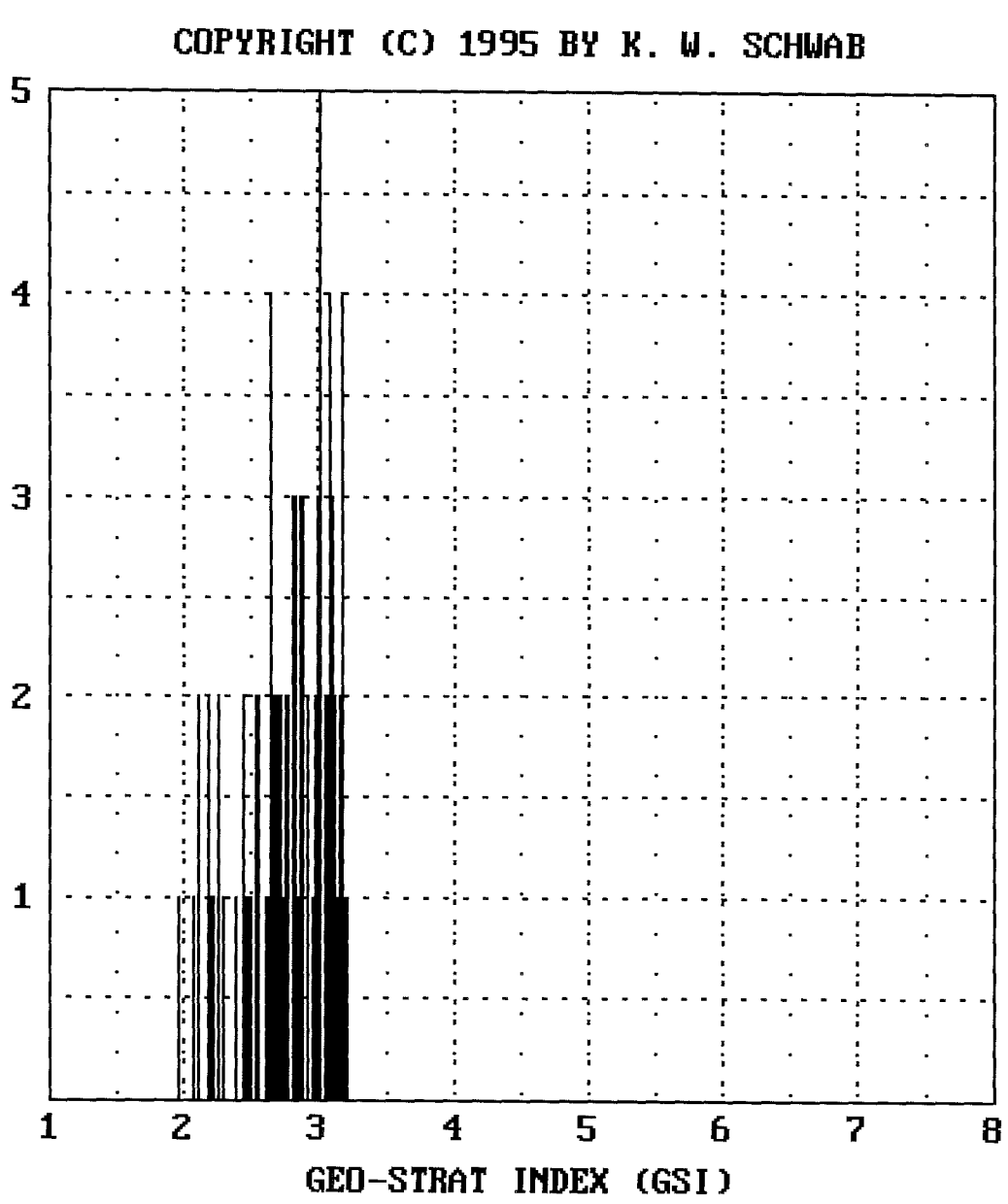
Counts = 76

Total Population

Min	Max	Avg	S-D
0.31	0.59	0.45	0.08

EDITED


COPYRIGHT (C) 1994 by KARL W. SCHWAB
File Name : AZ878-07
Sample Id : ALPINE FED. #1
Client : CORE: AZ878-07
Location : APACHE CO., AZ.
Depth : 3372'
Analyst : K. W. SCHWAB
Slope = 1.06
Hue 0 = -24.17
C/C = 0.95
Avg H = 86.66
Avg I = 67.31
Delete= 13
EDITED
INTENSITY
HUE
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
0 10 20 30 40 50 60 70 80 90 100 110 120



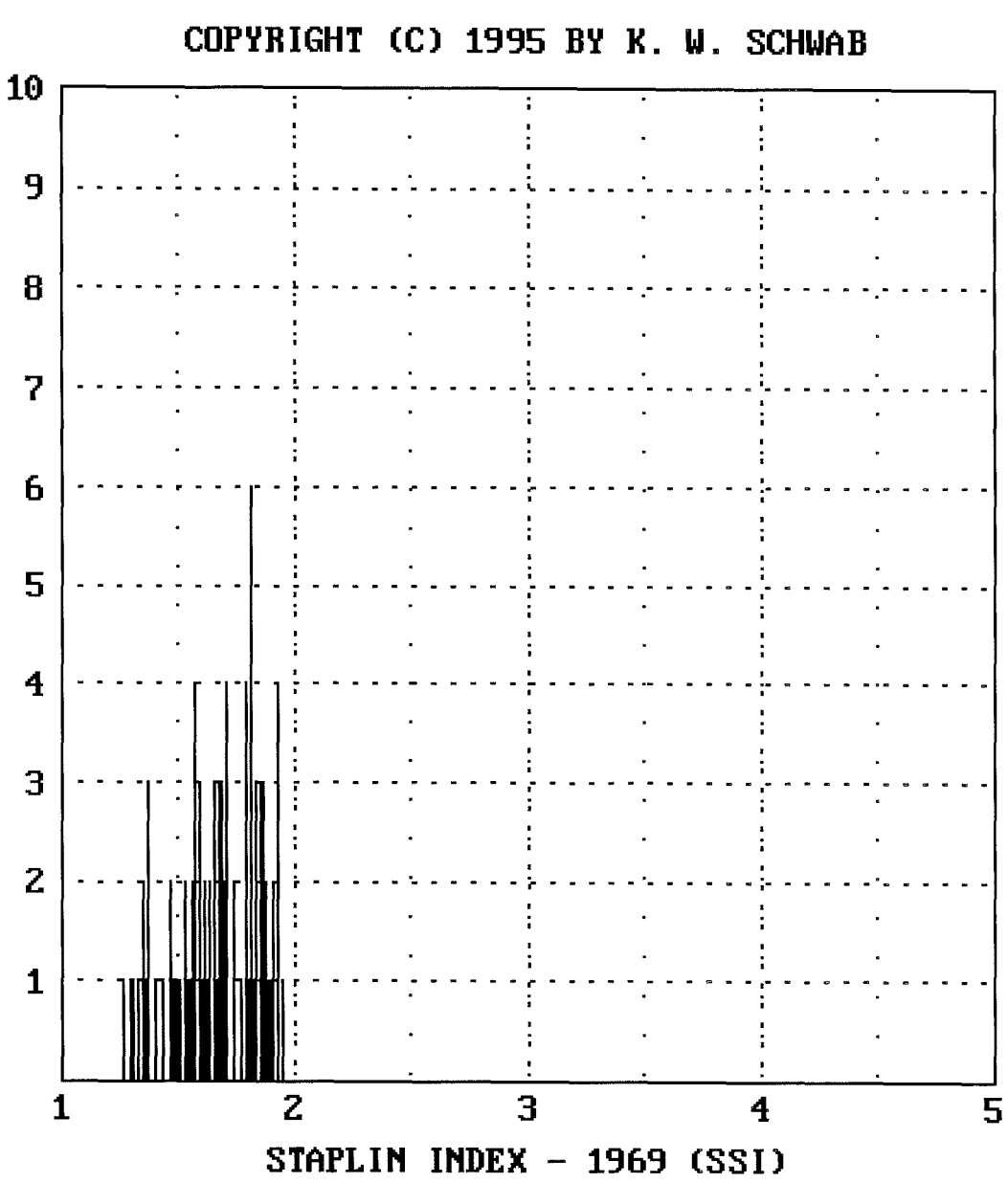
Sample : A2878-07
Depth : 3372'

Counts = 88

Total Population

Min	Max	Avg	S-D
1.95	3.23	2.78	0.31

EDITED



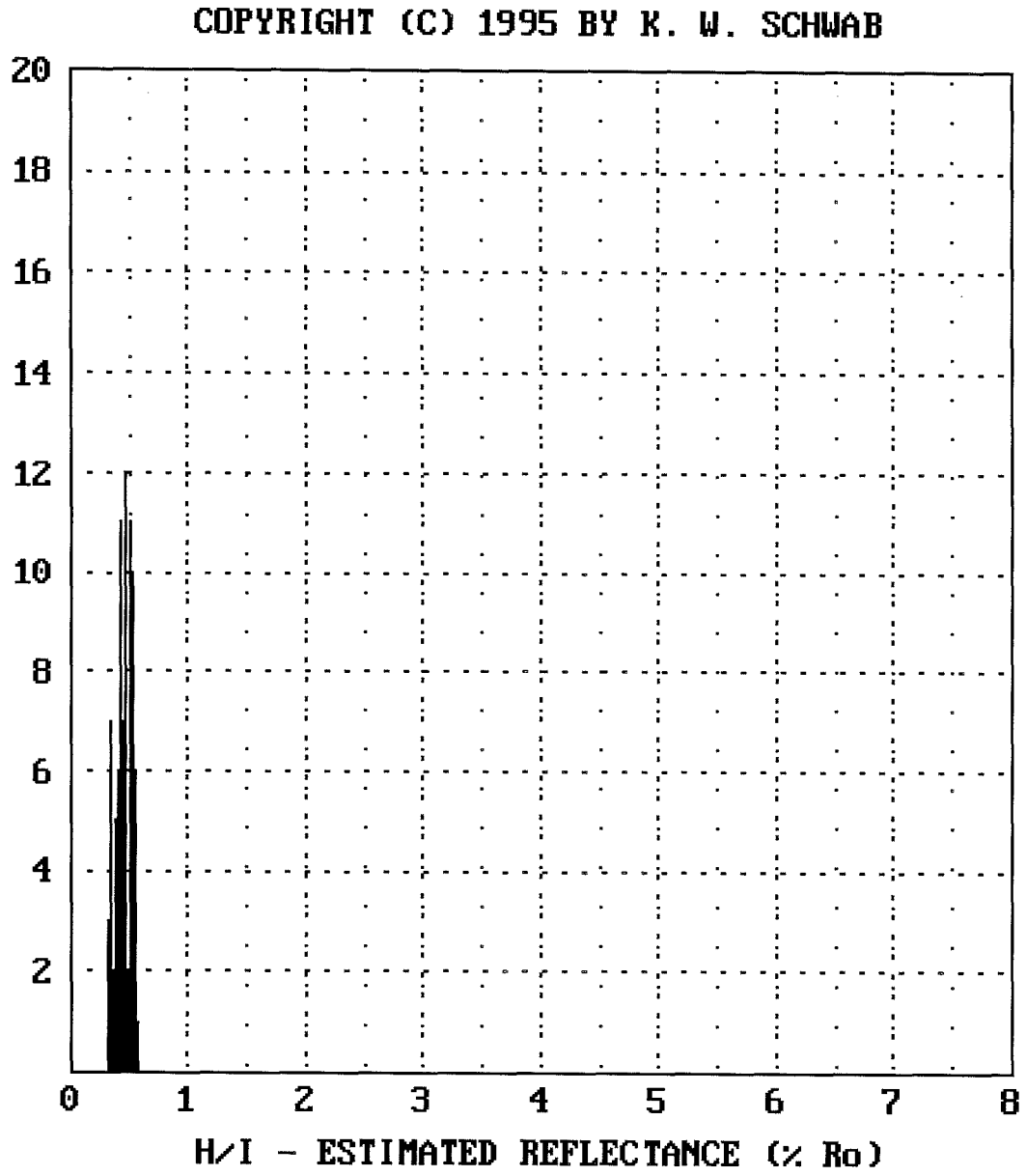
Sample : AZ878-07
Depth : 3372'

Counts = 88

Total Population

Min	Max	Avg	S-D
1.26	1.95	1.67	0.18

EDITED



Sample : A2878-07
Depth : 3372'

Counts = 88

Total Population

Min	Max	Avg	S-D
0.31	0.57	0.45	0.07

EDITED

VITRINITE REFLECTANCE DATA
(%Ro)

VITRINITE SUMMARY

SAMPLE FILE NAME	DEPTH/SAMPLE NUMBER	NO. OF OBSERVATIONS	MIN. %Ro.	MAX. %Ro.	AVG. %Ro.	STD. DEV.
AZ878-01	3,267'-3,274'	10	0.30	0.71	0.53	0.15
	POPULATION NO. 1	5	0.30	0.49	0.40	0.08 +
	POPULATION NO. 2	5	0.55	0.71	0.65	0.07
AZ878-02	3,286'-3,294'	90	0.30	2.69	0.86	0.50
	POPULATION NO. 1	47	0.30	0.64	0.46	0.09 +
	POPULATION NO. 2	34	0.84	1.43	1.15	0.17
	POPULATION NO. 3	5	1.55	1.69	1.59	0.06
	POPULATION NO. 4	3	1.98	2.15	2.07	0.09
	POPULATION NO. 5	1	2.69	2.69	2.69	0.00
AZ878-03	3,303'-3,312'	100	0.34	2.57	1.09	0.48
	POPULATION NO. 1	20	0.34	0.59	0.45	0.08 +
	POPULATION NO. 2	26	0.61	1.01	0.79	0.13
	POPULATION NO. 3	41	1.12	1.58	1.36	0.12
	POPULATION NO. 4	12	1.60	2.08	1.79	0.15
	POPULATION NO. 5	1	2.57	2.57	2.57	0.00
AZ878-04	3,321'-3,328'	100	0.35	1.90	1.08	0.42
	POPULATION NO. 1	12	0.35	0.53	0.45	0.06 +
	POPULATION NO. 2	24	0.55	0.88	0.68	0.09
	POPULATION NO. 3	36	0.95	1.36	1.17	0.11
	POPULATION NO. 4	27	1.41	1.83	1.57	0.14
	POPULATION NO. 5	1	1.90	1.90	1.90	0.00
AZ878-05	3,340'-3,349'	115	0.29	2.79	0.98	0.49
	POPULATION NO. 1	3	0.29	0.36	0.32	0.04 +
	POPULATION NO. 2	56	0.43	0.74	0.59	0.08
	POPULATION NO. 3	4	0.81	0.92	0.87	0.05
	POPULATION NO. 4	50	1.08	1.74	1.40	0.17
	POPULATION NO. 5	2	2.77	2.79	2.78	0.01
AZ878-06	3,361.5'-3,365'	60	0.47	1.87	0.90	0.38
	POPULATION NO. 1	38	0.47	0.85	0.64	0.10 +
	POPULATION NO. 2	8	0.95	1.22	1.09	0.09
	POPULATION NO. 3	12	1.32	1.60	1.44	0.10
	POPULATION NO. 4	2	1.72	1.87	1.80	0.11

+ POPULATION CONSIDERED TO BE IN SITU

STRATIGRAPHIC PROFILE TABLE
(THERMAL MATURITY)

CLIENT ID..... ARIZ. GEOL. SURVEY
FILE NAME/NO..... AZ-A
WELL NAME..... #1 ALPINE-FEDERAL
WELL OPERATOR.... SWTDI/NMSU
TYPE SAMPLES..... CORE CHIP
ANALYST..... K. W. SCHWAB

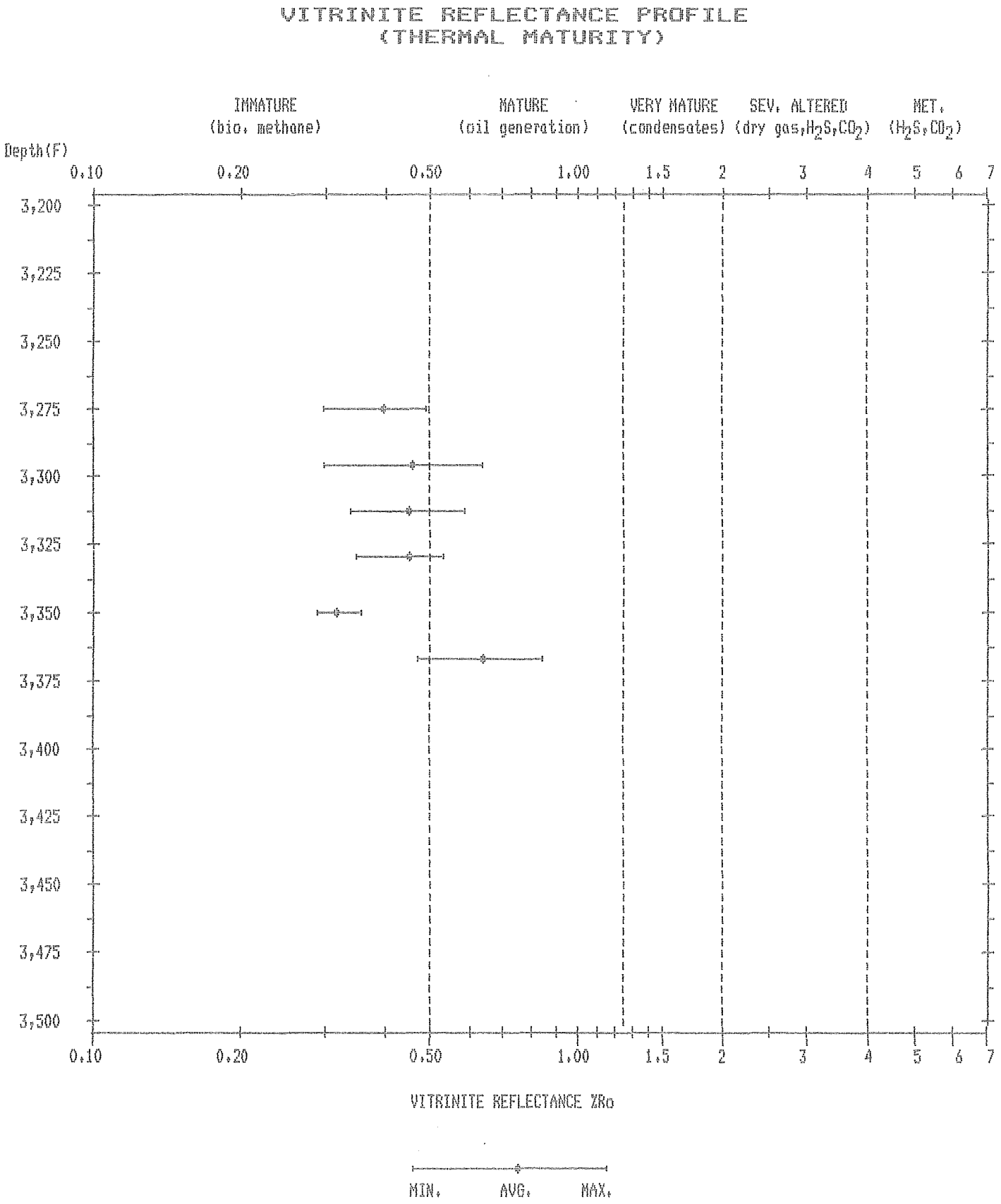
STATE..... ARIZONA
COUNTY..... APACHE
LOCATION..... T 6N, R 30E, SEC 23
AVG. DEPTH INTERVAL, 18
NO. VALUES PLOTTED,, 6
DATE..... 08-21-95

DATA POINTS USED TO CONSTRUCT PROFILE*

LINE No.	FILE NAME	DEPTH (FEET)	MIN %Ro	MAX %Ro	AVG %Ro	THERMAL MATURITY
1.	AZ878-01	3274	0.30	0.49	0.40	IMMATURE
2.	AZ878-02	3294	0.30	0.64	0.46	IMMATURE
3.	AZ878-03	3312	0.34	0.59	0.45	IMMATURE
4.	AZ878-04	3328	0.35	0.53	0.45	IMMATURE
5.	AZ878-05	3349	0.29	0.36	0.32	IMMATURE
6.	AZ878-06	3365	0.47	0.85	0.64	MATURE

*Values considered to be in situ

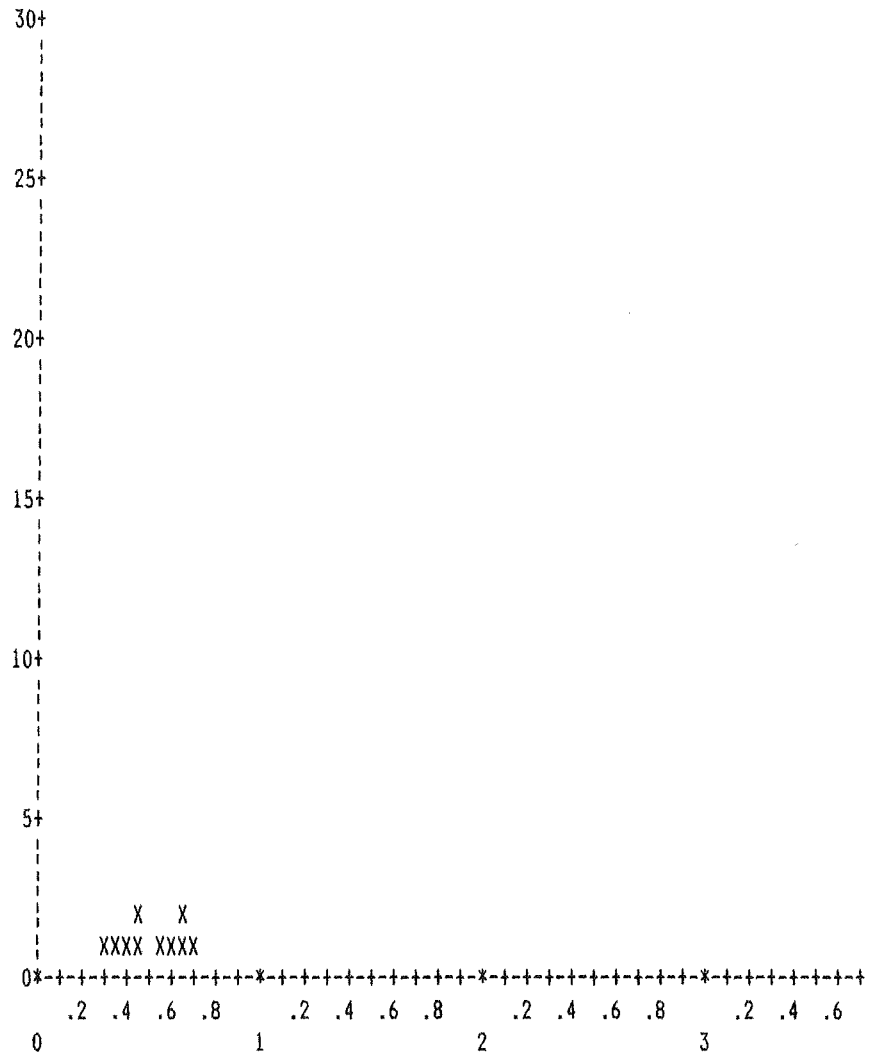
No. 1 Alpine-Federal
(Measured Vitrinite)



CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-01
DEPTH/SAMPLE NO..3,267'-3,274' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-21-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 10

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.30 MAX. 0.71 AVG. 0.53 STD. DEV. 0.15



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 5 MIN. 0.30 MAX. 0.49 AVG. 0.40 STD. DEV. 0.08 +

POP.# 2 TOTAL CTS. 5 MIN. 0.55 MAX. 0.71 AVG. 0.65 STD. DEV. 0.07

+ POPULATION CONSIDERED TO BE IN SITU

PAGE ONE OF TWO

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-01

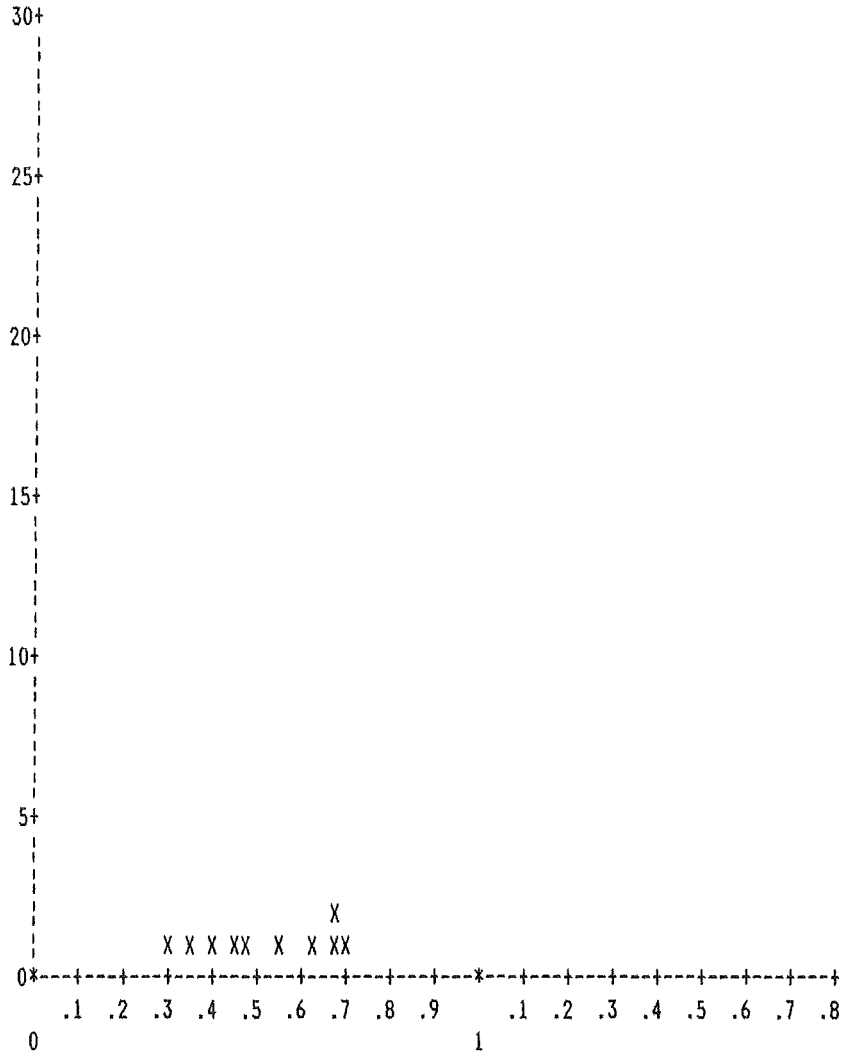
DATA POINTS:

1: 0.30
2: 0.35
3: 0.42
4: 0.46
5: 0.49
6: 0.55
7: 0.63
8: 0.69
9: 0.69
10: 0.71

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-01
DEPTH/SAMPLE NO..3,267'-3,274' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-21-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 10

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.30 MAX. 0.71 AVG. 0.53 STD. DEV. 0.15



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 5 MIN. 0.30 MAX. 0.49 AVG. 0.40 STD. DEV. 0.08 +

POP.# 2 TOTAL CTS. 5 MIN. 0.55 MAX. 0.71 AVG. 0.65 STD. DEV. 0.07

+ POPULATION CONSIDERED TO BE IN SITU

PAGE ONE OF TWO

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-01

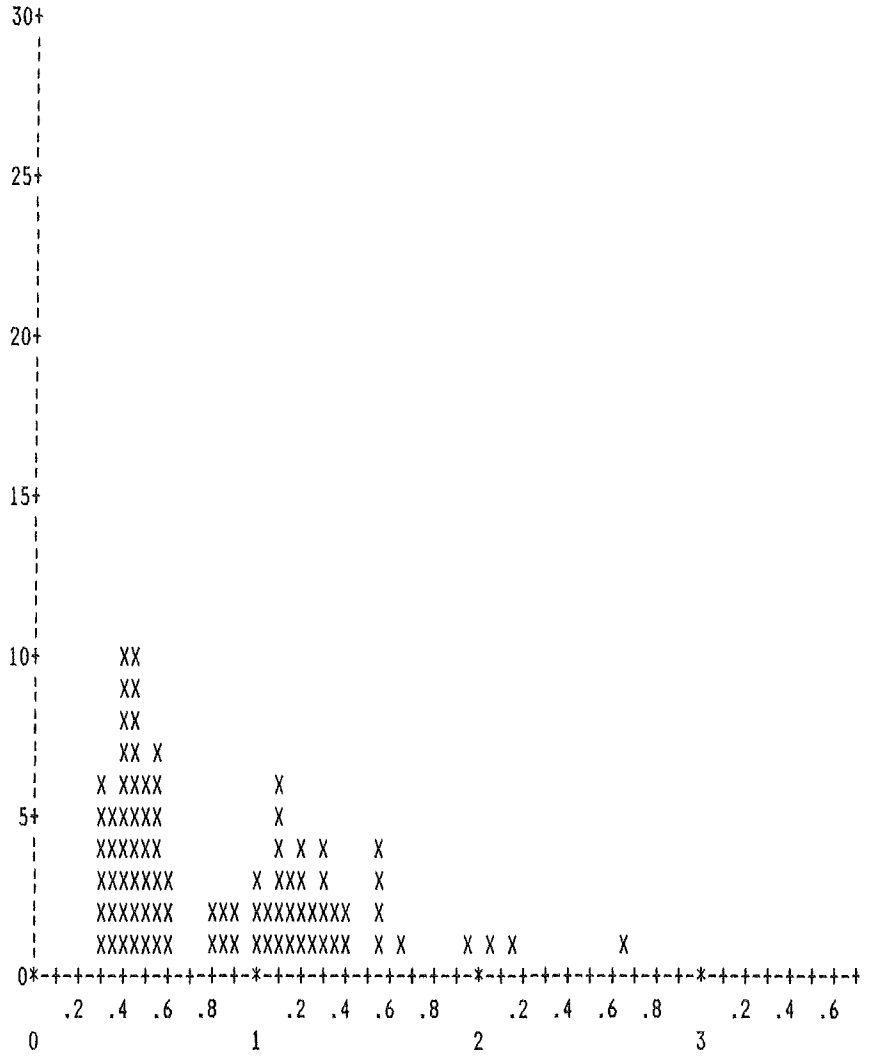
DATA POINTS:

1: 0.30
2: 0.35
3: 0.42
4: 0.46
5: 0.49
6: 0.55
7: 0.63
8: 0.69
9: 0.69
10: 0.71

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-02
DEPTH/SAMPLE NO..3,286'-3,294' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 90

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.30 MAX. 2.69 AVG. 0.86 STD. DEV. 0.50



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 47 MIN. 0.30 MAX. 0.64 AVG. 0.46 STD. DEV. 0.09 +

POP.# 2 TOTAL CTS. 34 MIN. 0.84 MAX. 1.43 AVG. 1.15 STD. DEV. 0.17

POP.# 3 TOTAL CTS. 5 MIN. 1.55 MAX. 1.69 AVG. 1.59 STD. DEV. 0.06

POP.# 4 TOTAL CTS. 3 MIN. 1.98 MAX. 2.15 AVG. 2.07 STD. DEV. 0.09

POP.# 5 TOTAL CTS. 1 MIN. 2.69 MAX. 2.69 AVG. 2.69 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-02

DATA POINTS:

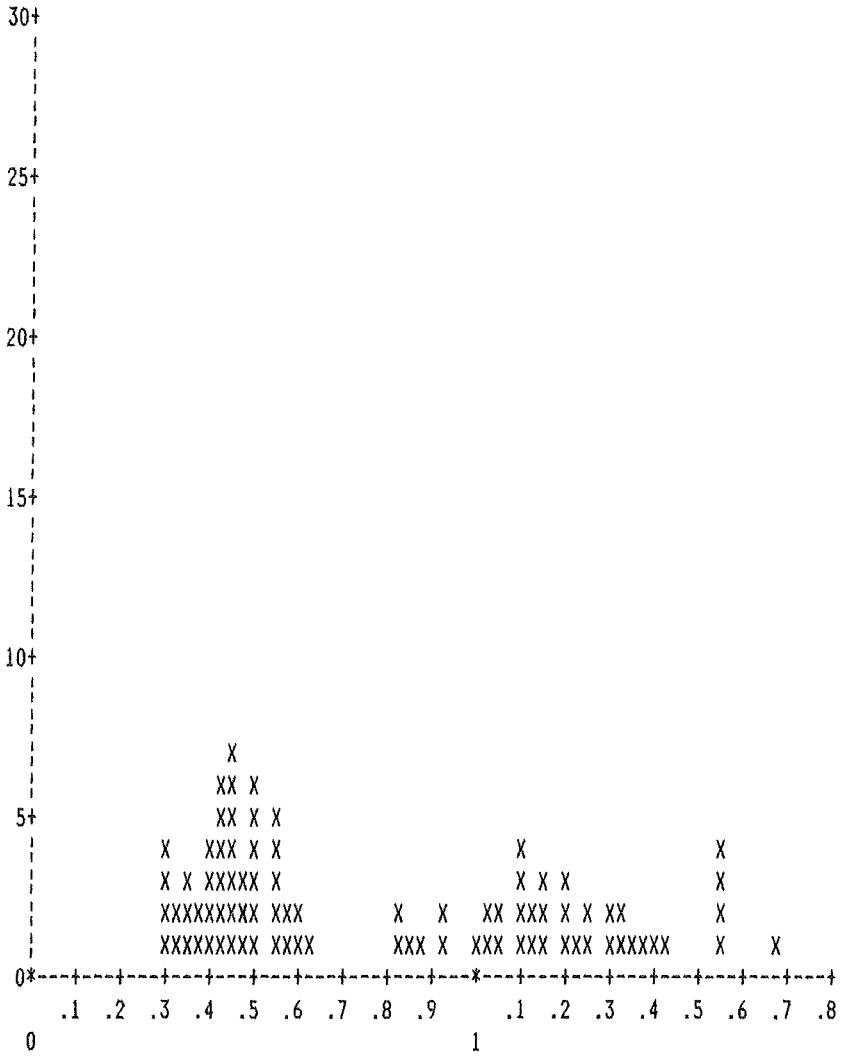
1:	0.30	51:	0.88
2:	0.32	52:	0.93
3:	0.32	53:	0.94
4:	0.32	54:	1.00
5:	0.33	55:	1.03
6:	0.34	56:	1.03
7:	0.35	57:	1.06
8:	0.36	58:	1.06
9:	0.36	59:	1.10
10:	0.39	60:	1.10
11:	0.39	61:	1.12
12:	0.40	62:	1.12
13:	0.40	63:	1.14
14:	0.41	64:	1.14
15:	0.41	65:	1.16
16:	0.43	66:	1.16
17:	0.43	67:	1.16
18:	0.43	68:	1.20
19:	0.44	69:	1.22
20:	0.44	70:	1.22
21:	0.44	71:	1.24
22:	0.45	72:	1.25
23:	0.45	73:	1.27
24:	0.45	74:	1.30
25:	0.45	75:	1.32
26:	0.45	76:	1.34
27:	0.46	77:	1.34
28:	0.46	78:	1.36
29:	0.48	79:	1.38
30:	0.49	80:	1.40
31:	0.49	81:	1.43
32:	0.50	82:	1.55
33:	0.51	83:	1.56
34:	0.51	84:	1.57
35:	0.52	85:	1.57
36:	0.52	86:	1.69
37:	0.52	87:	1.98
38:	0.55	88:	2.08
39:	0.55	89:	2.15
40:	0.55	90:	2.69
41:	0.56		
42:	0.57		
43:	0.58		
44:	0.59		
45:	0.60		
46:	0.61		
47:	0.64		
48:	0.84		
49:	0.84		
50:	0.85		

PAGE TWO OF TWO

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-02
DEPTH/SAMPLE NO..3,286'-3,294' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 90

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.30 MAX. 2.69 AVG. 0.86 STD. DEV. 0.50



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 47 MIN. 0.30 MAX. 0.64 AVG. 0.46 STD. DEV. 0.09 +

POP.# 2 TOTAL CTS. 34 MIN. 0.84 MAX. 1.43 AVG. 1.15 STD. DEV. 0.17

POP.# 3 TOTAL CTS. 5 MIN. 1.55 MAX. 1.69 AVG. 1.59 STD. DEV. 0.06

POP.# 4 TOTAL CTS. 3 MIN. 1.98 MAX. 2.15 AVG. 2.07 STD. DEV. 0.09

POP.# 5 TOTAL CTS. 1 MIN. 2.69 MAX. 2.69 AVG. 2.69 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-02

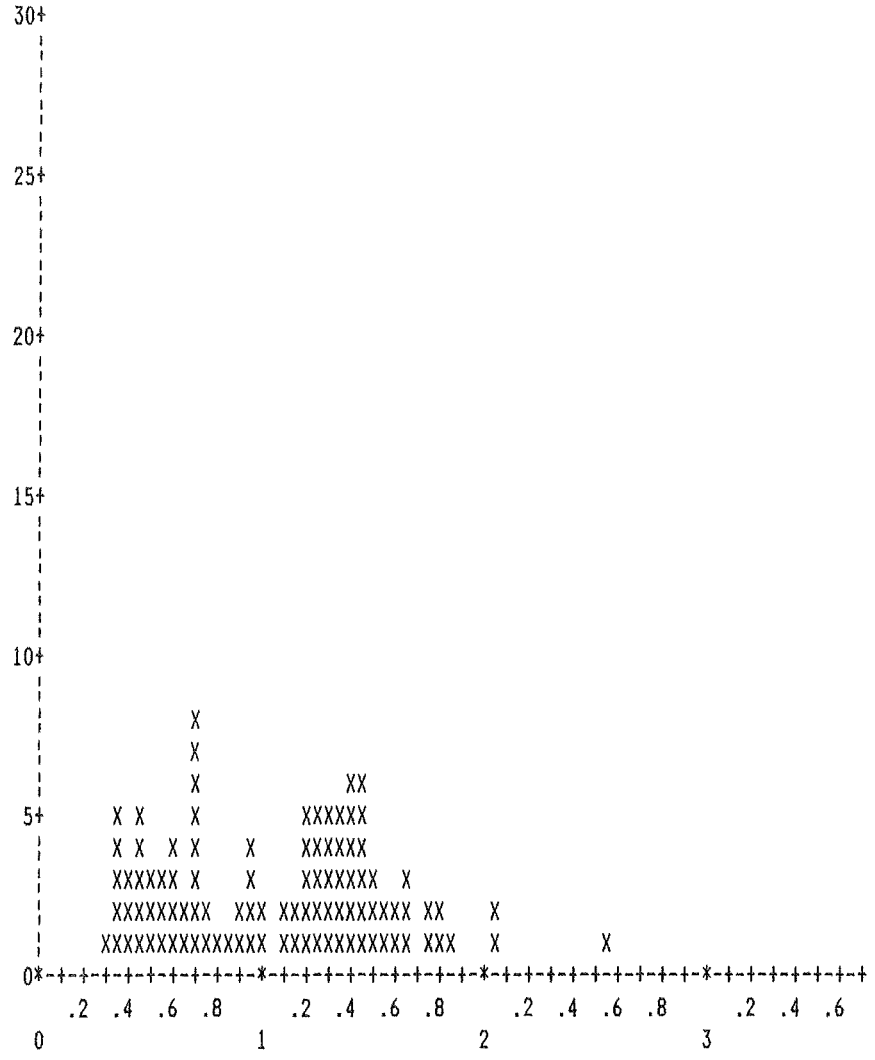
DATA POINTS:

1:	0.30	51:	0.88
2:	0.32	52:	0.93
3:	0.32	53:	0.94
4:	0.32	54:	1.00
5:	0.33	55:	1.03
6:	0.34	56:	1.03
7:	0.35	57:	1.06
8:	0.36	58:	1.06
9:	0.36	59:	1.10
10:	0.39	60:	1.10
11:	0.39	61:	1.12
12:	0.40	62:	1.12
13:	0.40	63:	1.14
14:	0.41	64:	1.14
15:	0.41	65:	1.16
16:	0.43	66:	1.16
17:	0.43	67:	1.16
18:	0.43	68:	1.20
19:	0.44	69:	1.22
20:	0.44	70:	1.22
21:	0.44	71:	1.24
22:	0.45	72:	1.25
23:	0.45	73:	1.27
24:	0.45	74:	1.30
25:	0.45	75:	1.32
26:	0.45	76:	1.34
27:	0.46	77:	1.34
28:	0.46	78:	1.36
29:	0.48	79:	1.38
30:	0.49	80:	1.40
31:	0.49	81:	1.43
32:	0.50	82:	1.55
33:	0.51	83:	1.56
34:	0.51	84:	1.57
35:	0.52	85:	1.57
36:	0.52	86:	1.69
37:	0.52	87:	1.98
38:	0.55	88:	2.08
39:	0.55	89:	2.15
40:	0.55	90:	2.69
41:	0.56		
42:	0.57		
43:	0.58		
44:	0.59		
45:	0.60		
46:	0.61		
47:	0.64		
48:	0.84		
49:	0.84		
50:	0.85		

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-03
DEPTH/SAMPLE NO..3,303'-3,312' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 100

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.34 MAX. 2.57 AVG. 1.09 STD. DEV. 0.48



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 20 MIN. 0.34 MAX. 0.59 AVG. 0.45 STD. DEV. 0.08 +

POP.# 2 TOTAL CTS. 26 MIN. 0.61 MAX. 1.01 AVG. 0.79 STD. DEV. 0.13

POP.# 3 TOTAL CTS. 41 MIN. 1.12 MAX. 1.58 AVG. 1.36 STD. DEV. 0.12

POP.# 4 TOTAL CTS. 12 MIN. 1.60 MAX. 2.08 AVG. 1.79 STD. DEV. 0.15

POP.# 5 TOTAL CTS. 1 MIN. 2.57 MAX. 2.57 AVG. 2.57 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-03

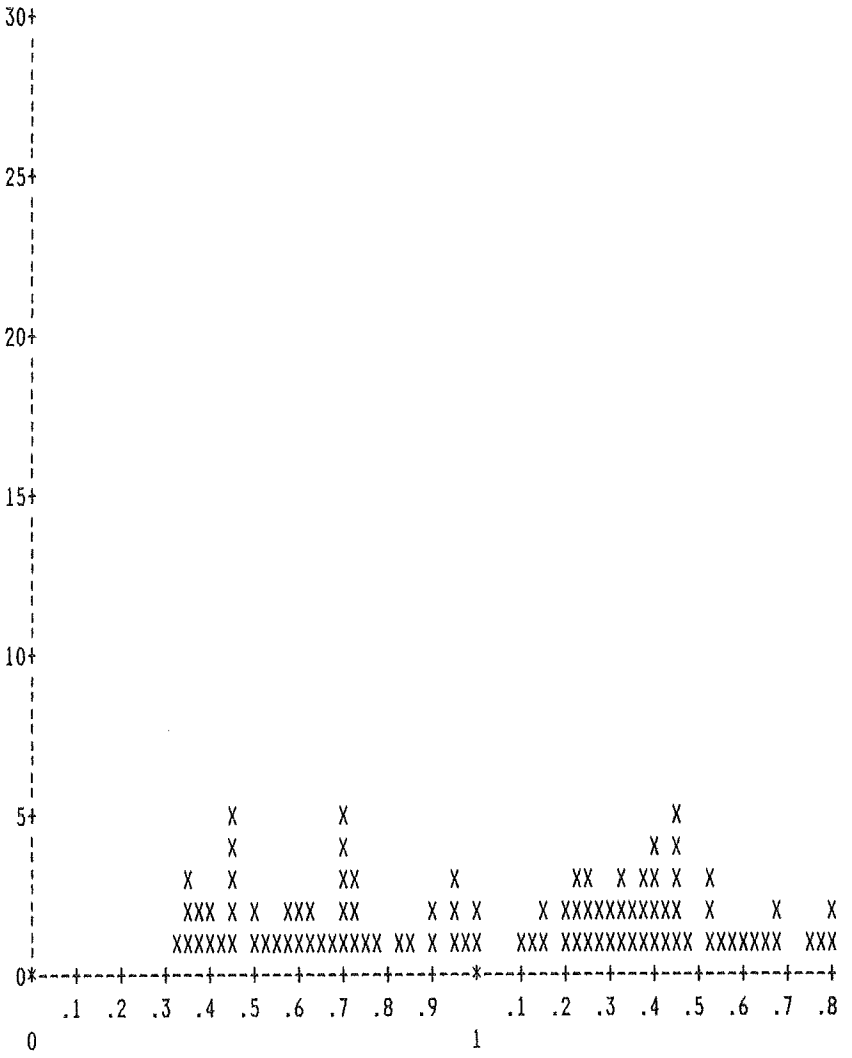
DATA POINTS:

1:	0.34	51:	1.21
2:	0.35	52:	1.22
3:	0.36	53:	1.23
4:	0.37	54:	1.23
5:	0.39	55:	1.24
6:	0.39	56:	1.26
7:	0.40	57:	1.27
8:	0.42	58:	1.27
9:	0.43	59:	1.28
10:	0.45	60:	1.28
11:	0.46	61:	1.31
12:	0.46	62:	1.32
13:	0.47	63:	1.33
14:	0.47	64:	1.34
15:	0.50	65:	1.34
16:	0.51	66:	1.36
17:	0.54	67:	1.37
18:	0.56	68:	1.39
19:	0.59	69:	1.39
20:	0.59	70:	1.39
21:	0.61	71:	1.40
22:	0.62	72:	1.40
23:	0.64	73:	1.42
24:	0.64	74:	1.42
25:	0.66	75:	1.43
26:	0.69	76:	1.44
27:	0.70	77:	1.45
28:	0.70	78:	1.45
29:	0.70	79:	1.46
30:	0.72	80:	1.47
31:	0.72	81:	1.47
32:	0.74	82:	1.49
33:	0.74	83:	1.53
34:	0.74	84:	1.53
35:	0.76	85:	1.54
36:	0.79	86:	1.56
37:	0.84	87:	1.58
38:	0.85	88:	1.60
39:	0.90	89:	1.64
40:	0.92	90:	1.67
41:	0.95	91:	1.69
42:	0.97	92:	1.69
43:	0.97	93:	1.75
44:	0.98	94:	1.78
45:	1.01	95:	1.81
46:	1.01	96:	1.81
47:	1.12	97:	1.89
48:	1.14	98:	2.06
49:	1.15	99:	2.08
50:	1.16	100:	2.57

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-03
DEPTH/SAMPLE NO..3,303'-3,312' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 100

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.34 MAX. 2.57 AVG. 1.09 STD. DEV. 0.48



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 20 MIN. 0.34 MAX. 0.59 AVG. 0.45 STD. DEV. 0.08 +

POP.# 2 TOTAL CTS. 26 MIN. 0.61 MAX. 1.01 AVG. 0.79 STD. DEV. 0.13

POP.# 3 TOTAL CTS. 41 MIN. 1.12 MAX. 1.58 AVG. 1.36 STD. DEV. 0.12

POP.# 4 TOTAL CTS. 12 MIN. 1.60 MAX. 2.08 AVG. 1.79 STD. DEV. 0.15

POP.# 5 TOTAL CTS. 1 MIN. 2.57 MAX. 2.57 AVG. 2.57 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-03

DATA POINTS:

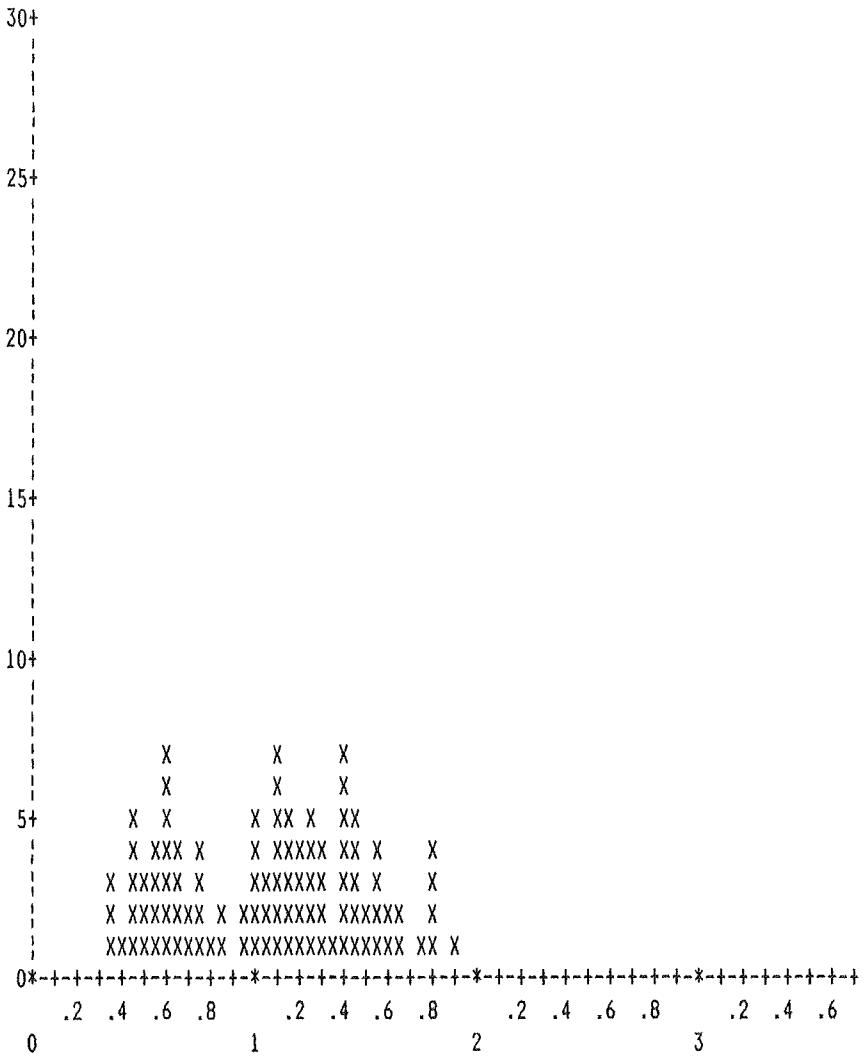
1:	0.34	51:	1.21
2:	0.35	52:	1.22
3:	0.36	53:	1.23
4:	0.37	54:	1.23
5:	0.39	55:	1.24
6:	0.39	56:	1.26
7:	0.40	57:	1.27
8:	0.42	58:	1.27
9:	0.43	59:	1.28
10:	0.45	60:	1.28
11:	0.46	61:	1.31
12:	0.46	62:	1.32
13:	0.47	63:	1.33
14:	0.47	64:	1.34
15:	0.50	65:	1.34
16:	0.51	66:	1.36
17:	0.54	67:	1.37
18:	0.56	68:	1.39
19:	0.59	69:	1.39
20:	0.59	70:	1.39
21:	0.61	71:	1.40
22:	0.62	72:	1.40
23:	0.64	73:	1.42
24:	0.64	74:	1.42
25:	0.66	75:	1.43
26:	0.69	76:	1.44
27:	0.70	77:	1.45
28:	0.70	78:	1.45
29:	0.70	79:	1.46
30:	0.72	80:	1.47
31:	0.72	81:	1.47
32:	0.74	82:	1.49
33:	0.74	83:	1.53
34:	0.74	84:	1.53
35:	0.76	85:	1.54
36:	0.79	86:	1.56
37:	0.84	87:	1.58
38:	0.85	88:	1.60
39:	0.90	89:	1.64
40:	0.92	90:	1.67
41:	0.95	91:	1.69
42:	0.97	92:	1.69
43:	0.97	93:	1.75
44:	0.98	94:	1.78
45:	1.01	95:	1.81
46:	1.01	96:	1.81
47:	1.12	97:	1.89
48:	1.14	98:	2.06
49:	1.15	99:	2.08
50:	1.16	100:	2.57

PAGE TWO OF TWO

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-04
DEPTH/SAMPLE NO..3,321'-3,328' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 100

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.35 MAX. 1.90 AVG. 1.08 STD. DEV. 0.42



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 12 MIN. 0.35 MAX. 0.53 AVG. 0.45 STD. DEV. 0.06 +

POP.# 2 TOTAL CTS. 24 MIN. 0.55 MAX. 0.88 AVG. 0.68 STD. DEV. 0.09

POP.# 3 TOTAL CTS. 36 MIN. 0.95 MAX. 1.36 AVG. 1.17 STD. DEV. 0.11

POP.# 4 TOTAL CTS. 27 MIN. 1.41 MAX. 1.83 AVG. 1.57 STD. DEV. 0.14

POP.# 5 TOTAL CTS. 1 MIN. 1.90 MAX. 1.90 AVG. 1.90 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-04

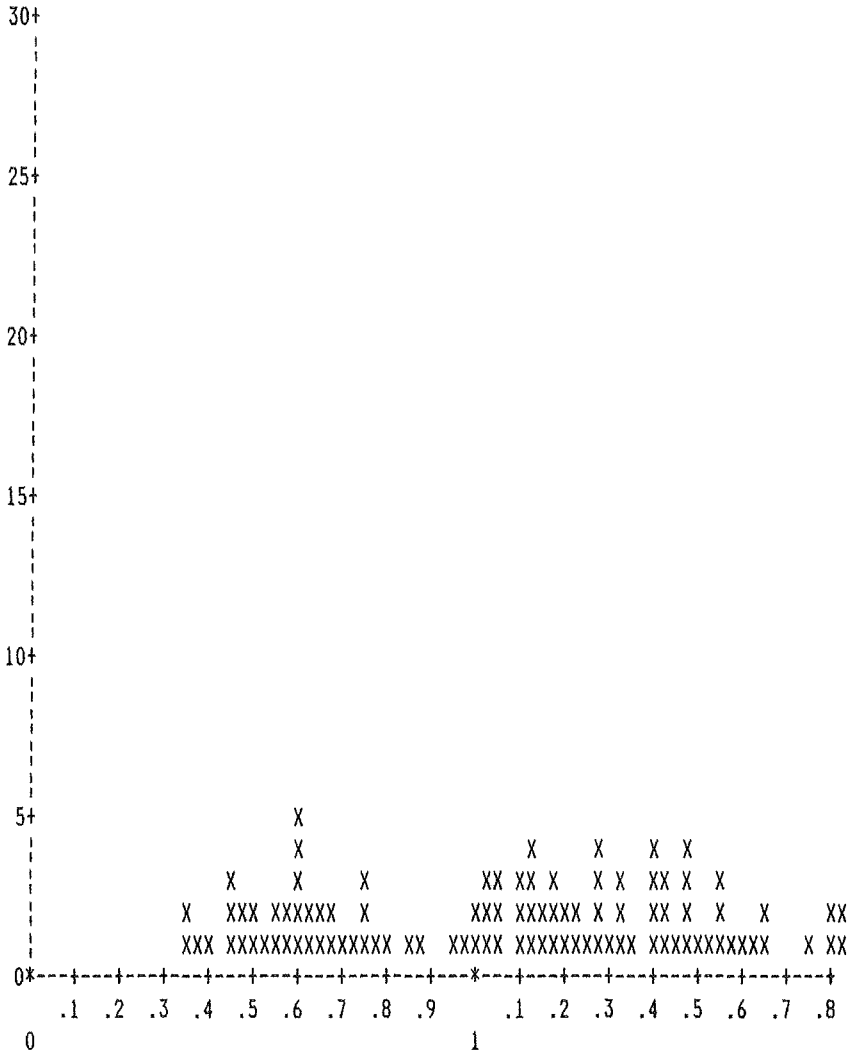
DATA POINTS:

1:	0.35	51:	1.13
2:	0.37	52:	1.14
3:	0.39	53:	1.14
4:	0.40	54:	1.15
5:	0.45	55:	1.17
6:	0.47	56:	1.18
7:	0.47	57:	1.19
8:	0.48	58:	1.19
9:	0.48	59:	1.21
10:	0.50	60:	1.22
11:	0.50	61:	1.23
12:	0.53	62:	1.23
13:	0.55	63:	1.25
14:	0.57	64:	1.28
15:	0.58	65:	1.28
16:	0.58	66:	1.29
17:	0.60	67:	1.29
18:	0.61	68:	1.30
19:	0.61	69:	1.33
20:	0.61	70:	1.33
21:	0.62	71:	1.34
22:	0.63	72:	1.36
23:	0.64	73:	1.41
24:	0.67	74:	1.41
25:	0.67	75:	1.42
26:	0.68	76:	1.42
27:	0.69	77:	1.43
28:	0.70	78:	1.44
29:	0.73	79:	1.44
30:	0.76	80:	1.47
31:	0.76	81:	1.48
32:	0.77	82:	1.48
33:	0.78	83:	1.49
34:	0.82	84:	1.49
35:	0.87	85:	1.50
36:	0.88	86:	1.54
37:	0.95	87:	1.55
38:	0.99	88:	1.56
39:	1.02	89:	1.57
40:	1.02	90:	1.59
41:	1.03	91:	1.61
42:	1.03	92:	1.63
43:	1.04	93:	1.65
44:	1.06	94:	1.66
45:	1.06	95:	1.76
46:	1.07	96:	1.81
47:	1.10	97:	1.82
48:	1.12	98:	1.83
49:	1.12	99:	1.83
50:	1.13	100:	1.90

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-04
DEPTH/SAMPLE NO..3,321'-3,328' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 100

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.35 MAX. 1.90 AVG. 1.08 STD. DEV. 0.42



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 12 MIN. 0.35 MAX. 0.53 AVG. 0.45 STD. DEV. 0.06 +

POP.# 2 TOTAL CTS. 24 MIN. 0.55 MAX. 0.88 AVG. 0.68 STD. DEV. 0.09

POP.# 3 TOTAL CTS. 36 MIN. 0.95 MAX. 1.36 AVG. 1.17 STD. DEV. 0.11

POP.# 4 TOTAL CTS. 27 MIN. 1.41 MAX. 1.83 AVG. 1.57 STD. DEV. 0.14

POP.# 5 TOTAL CTS. 1 MIN. 1.90 MAX. 1.90 AVG. 1.90 STD. DEV. 0.00

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-04

DATA POINTS:

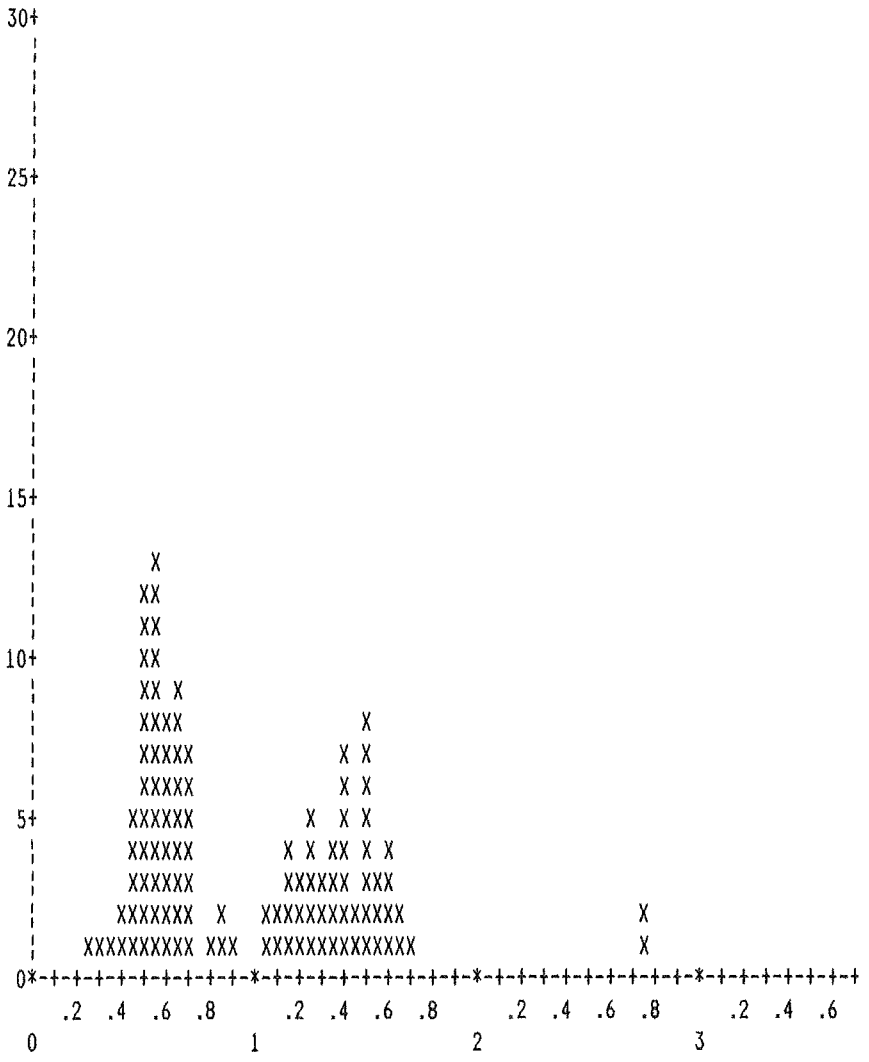
1:	0.35	51:	1.13
2:	0.37	52:	1.14
3:	0.39	53:	1.14
4:	0.40	54:	1.15
5:	0.45	55:	1.17
6:	0.47	56:	1.18
7:	0.47	57:	1.19
8:	0.48	58:	1.19
9:	0.48	59:	1.21
10:	0.50	60:	1.22
11:	0.50	61:	1.23
12:	0.53	62:	1.23
13:	0.55	63:	1.25
14:	0.57	64:	1.28
15:	0.58	65:	1.28
16:	0.58	66:	1.29
17:	0.60	67:	1.29
18:	0.61	68:	1.30
19:	0.61	69:	1.33
20:	0.61	70:	1.33
21:	0.62	71:	1.34
22:	0.63	72:	1.36
23:	0.64	73:	1.41
24:	0.67	74:	1.41
25:	0.67	75:	1.42
26:	0.68	76:	1.42
27:	0.69	77:	1.43
28:	0.70	78:	1.44
29:	0.73	79:	1.44
30:	0.76	80:	1.47
31:	0.76	81:	1.48
32:	0.77	82:	1.48
33:	0.78	83:	1.49
34:	0.82	84:	1.49
35:	0.87	85:	1.50
36:	0.88	86:	1.54
37:	0.95	87:	1.55
38:	0.99	88:	1.56
39:	1.02	89:	1.57
40:	1.02	90:	1.59
41:	1.03	91:	1.61
42:	1.03	92:	1.63
43:	1.04	93:	1.65
44:	1.06	94:	1.66
45:	1.06	95:	1.76
46:	1.07	96:	1.81
47:	1.10	97:	1.82
48:	1.12	98:	1.83
49:	1.12	99:	1.83
50:	1.13	100:	1.90

PAGE TWO OF TWO

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-05
DEPTH/SAMPLE NO..3,340'-3,349' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 115

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.29 MAX. 2.79 AVG. 0.98 STD. DEV. 0.49



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 3 MIN. 0.29 MAX. 0.36 AVG. 0.32 STD. DEV. 0.04 +

POP.# 2 TOTAL CTS. 56 MIN. 0.43 MAX. 0.74 AVG. 0.59 STD. DEV. 0.08

POP.# 3 TOTAL CTS. 4 MIN. 0.81 MAX. 0.92 AVG. 0.87 STD. DEV. 0.05

POP.# 4 TOTAL CTS. 50 MIN. 1.08 MAX. 1.74 AVG. 1.40 STD. DEV. 0.17

POP.# 5 TOTAL CTS. 2 MIN. 2.77 MAX. 2.79 AVG. 2.78 STD. DEV. 0.01

+ POPULATION CONSIDERED TO BE IN SITU

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-05

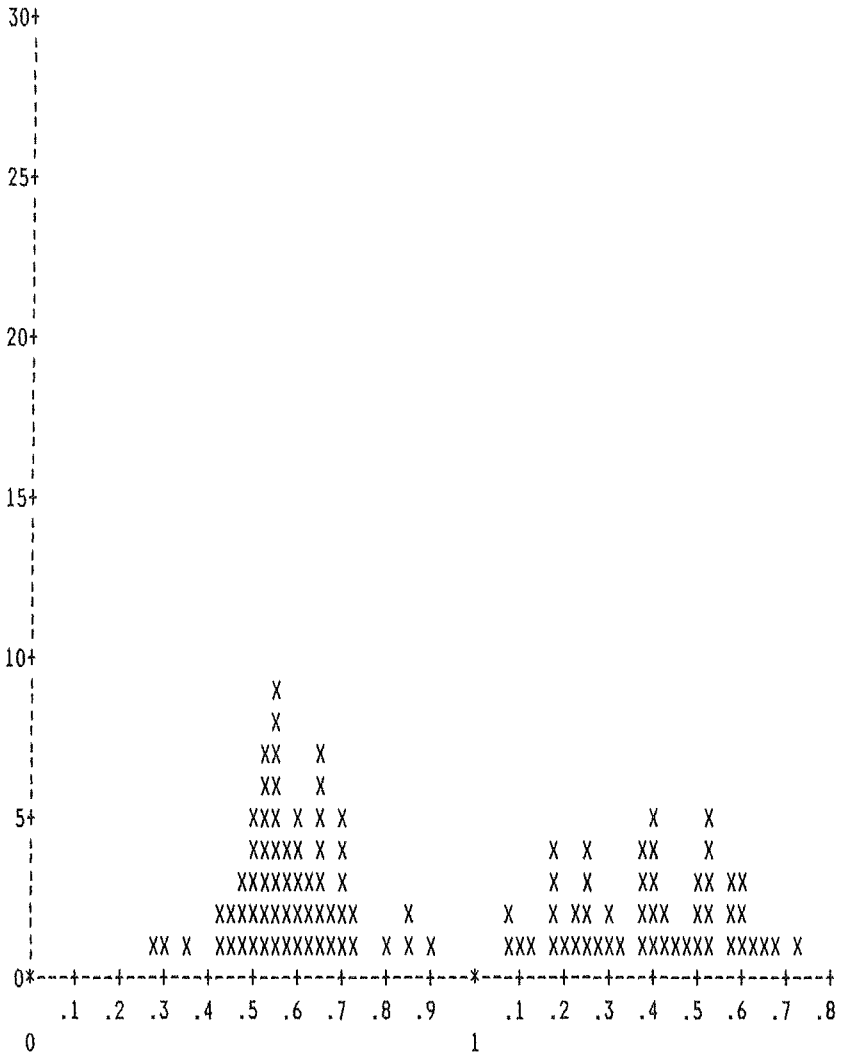
DATA POINTS:

1: 0.29	51: 0.68	101: 1.54
2: 0.32	52: 0.69	102: 1.54
3: 0.36	53: 0.70	103: 1.54
4: 0.43	54: 0.71	104: 1.58
5: 0.44	55: 0.72	105: 1.58
6: 0.45	56: 0.72	106: 1.59
7: 0.46	57: 0.72	107: 1.60
8: 0.48	58: 0.74	108: 1.60
9: 0.49	59: 0.74	109: 1.61
10: 0.49	60: 0.81	110: 1.64
11: 0.50	61: 0.86	111: 1.65
12: 0.50	62: 0.87	112: 1.68
13: 0.50	63: 0.92	113: 1.74
14: 0.51	64: 1.08	114: 2.77
15: 0.52	65: 1.09	115: 2.79
16: 0.53	66: 1.12	
17: 0.53	67: 1.13	
18: 0.53	68: 1.18	
19: 0.54	69: 1.18	
20: 0.54	70: 1.18	
21: 0.54	71: 1.19	
22: 0.54	72: 1.21	
23: 0.55	73: 1.24	
24: 0.55	74: 1.24	
25: 0.56	75: 1.25	
26: 0.56	76: 1.26	
27: 0.56	77: 1.27	
28: 0.56	78: 1.27	
29: 0.57	79: 1.29	
30: 0.57	80: 1.31	
31: 0.57	81: 1.32	
32: 0.58	82: 1.34	
33: 0.58	83: 1.38	
34: 0.58	84: 1.38	
35: 0.59	85: 1.39	
36: 0.60	86: 1.39	
37: 0.61	87: 1.40	
38: 0.61	88: 1.40	
39: 0.61	89: 1.42	
40: 0.61	90: 1.42	
41: 0.64	91: 1.42	
42: 0.64	92: 1.44	
43: 0.64	93: 1.44	
44: 0.65	94: 1.45	
45: 0.66	95: 1.49	
46: 0.66	96: 1.50	
47: 0.66	97: 1.50	
48: 0.66	98: 1.50	
49: 0.66	99: 1.53	
50: 0.67	100: 1.53	

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-05
DEPTH/SAMPLE NO..3,340'-3,349' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 115

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.29 MAX. 2.79 AVG. 0.98 STD. DEV. 0.49



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 3 MIN. 0.29 MAX. 0.36 AVG. 0.32 STD. DEV. 0.04 +

POP.# 2 TOTAL CTS. 56 MIN. 0.43 MAX. 0.74 AVG. 0.59 STD. DEV. 0.08

POP.# 3 TOTAL CTS. 4 MIN. 0.81 MAX. 0.92 AVG. 0.87 STD. DEV. 0.05

POP.# 4 TOTAL CTS. 50 MIN. 1.08 MAX. 1.74 AVG. 1.40 STD. DEV. 0.17

POP.# 5 TOTAL CTS. 2 MIN. 2.77 MAX. 2.79 AVG. 2.78 STD. DEV. 0.01

+ POPULATION CONSIDERED TO BE IN SITU

PAGE ONE OF TWO

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-05

DATA POINTS:

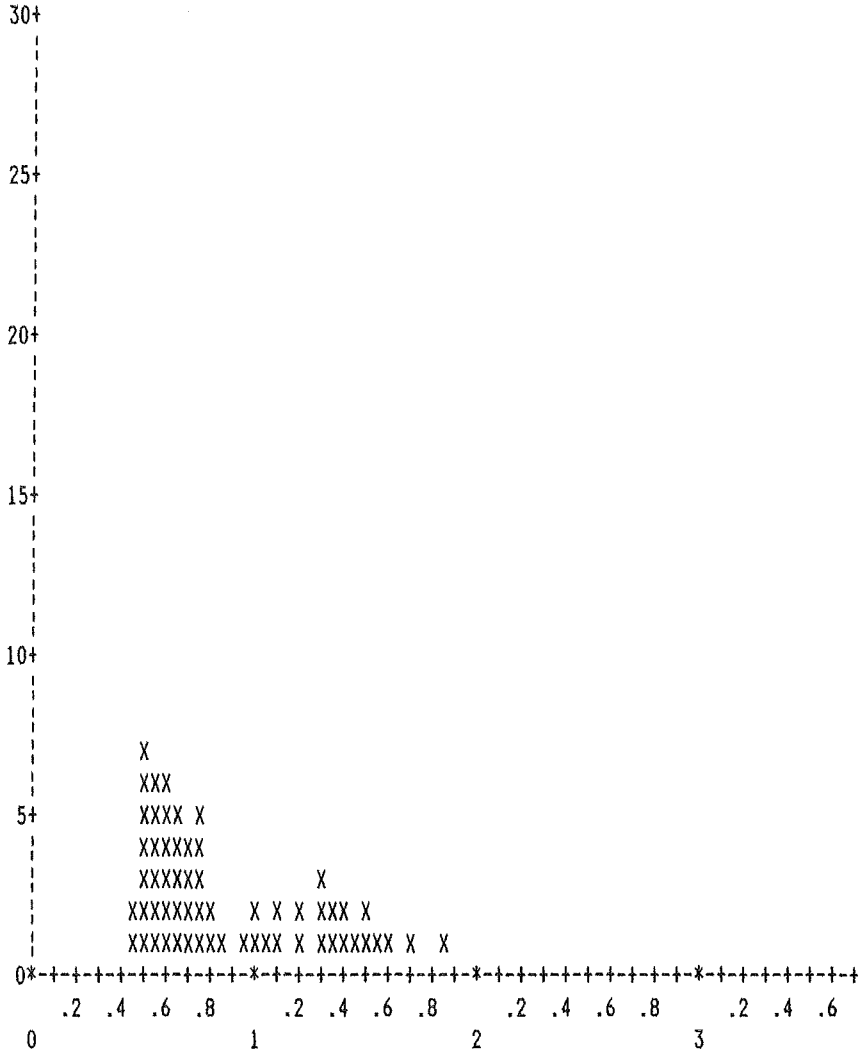
1: 0.29	51: 0.68	101: 1.54
2: 0.32	52: 0.69	102: 1.54
3: 0.36	53: 0.70	103: 1.54
4: 0.43	54: 0.71	104: 1.58
5: 0.44	55: 0.72	105: 1.58
6: 0.45	56: 0.72	106: 1.59
7: 0.46	57: 0.72	107: 1.60
8: 0.48	58: 0.74	108: 1.60
9: 0.49	59: 0.74	109: 1.61
10: 0.49	60: 0.81	110: 1.64
11: 0.50	61: 0.86	111: 1.65
12: 0.50	62: 0.87	112: 1.68
13: 0.50	63: 0.92	113: 1.74
14: 0.51	64: 1.08	114: 2.77
15: 0.52	65: 1.09	115: 2.79
16: 0.53	66: 1.12	
17: 0.53	67: 1.13	
18: 0.53	68: 1.18	
19: 0.54	69: 1.18	
20: 0.54	70: 1.18	
21: 0.54	71: 1.19	
22: 0.54	72: 1.21	
23: 0.55	73: 1.24	
24: 0.55	74: 1.24	
25: 0.56	75: 1.25	
26: 0.56	76: 1.26	
27: 0.56	77: 1.27	
28: 0.56	78: 1.27	
29: 0.57	79: 1.29	
30: 0.57	80: 1.31	
31: 0.57	81: 1.32	
32: 0.58	82: 1.34	
33: 0.58	83: 1.38	
34: 0.58	84: 1.38	
35: 0.59	85: 1.39	
36: 0.60	86: 1.39	
37: 0.61	87: 1.40	
38: 0.61	88: 1.40	
39: 0.61	89: 1.42	
40: 0.61	90: 1.42	
41: 0.64	91: 1.42	
42: 0.64	92: 1.44	
43: 0.64	93: 1.44	
44: 0.65	94: 1.45	
45: 0.66	95: 1.49	
46: 0.66	96: 1.50	
47: 0.66	97: 1.50	
48: 0.66	98: 1.50	
49: 0.66	99: 1.53	
50: 0.67	100: 1.53	

PAGE TWO OF TWO

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-06
DEPTH/SAMPLE NO..3,361.5'-3,365' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 60

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.47 MAX. 1.87 AVG. 0.90 STD. DEV. 0.38



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 38 MIN. 0.47 MAX. 0.85 AVG. 0.64 STD. DEV. 0.10 +

POP.# 2 TOTAL CTS. 8 MIN. 0.95 MAX. 1.22 AVG. 1.09 STD. DEV. 0.09

POP.# 3 TOTAL CTS. 12 MIN. 1.32 MAX. 1.60 AVG. 1.44 STD. DEV. 0.10

POP.# 4 TOTAL CTS. 2 MIN. 1.72 MAX. 1.87 AVG. 1.80 STD. DEV. 0.11

+ POPULATION CONSIDERED TO BE IN SITU

PAGE ONE OF TWO

COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-06

DATA POINTS:

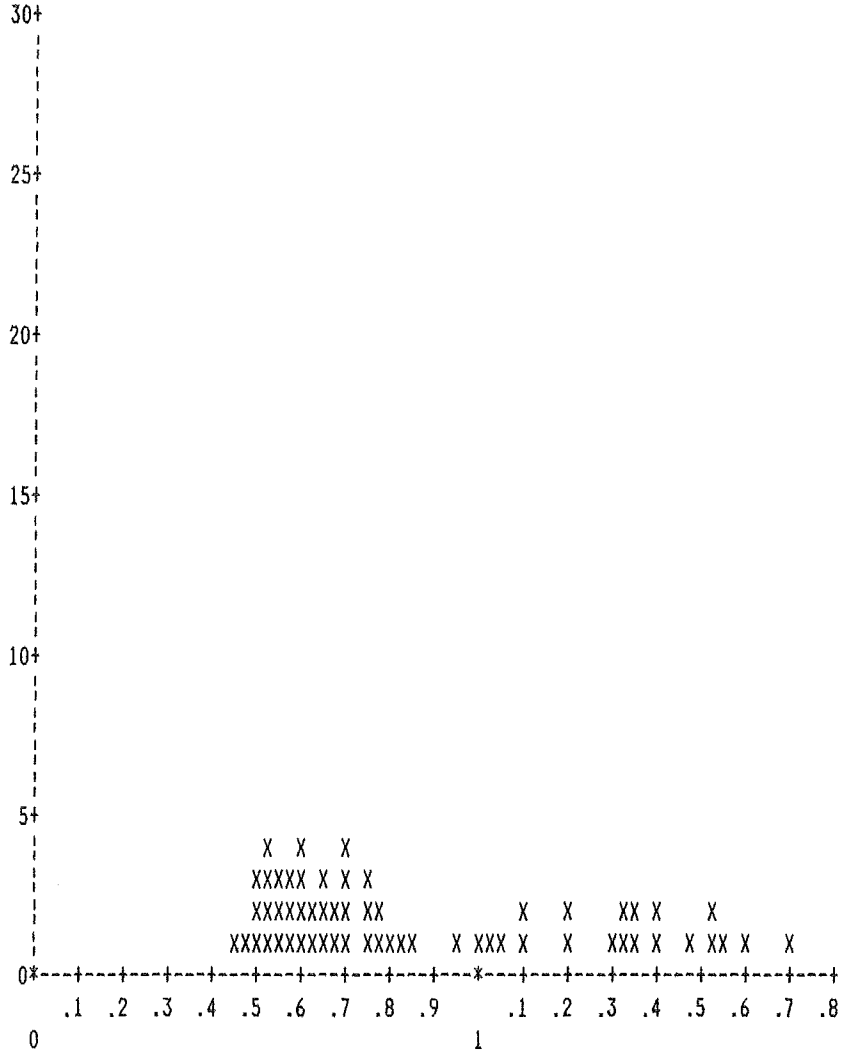
1:	0.47	51:	1.36
2:	0.48	52:	1.40
3:	0.51	53:	1.40
4:	0.52	54:	1.49
5:	0.52	55:	1.54
6:	0.53	56:	1.54
7:	0.54	57:	1.56
8:	0.54	58:	1.60
9:	0.54	59:	1.72
10:	0.55	60:	1.87
11:	0.55		
12:	0.57		
13:	0.58		
14:	0.59		
15:	0.59		
16:	0.60		
17:	0.61		
18:	0.61		
19:	0.62		
20:	0.63		
21:	0.64		
22:	0.65		
23:	0.65		
24:	0.66		
25:	0.68		
26:	0.68		
27:	0.70		
28:	0.70		
29:	0.71		
30:	0.72		
31:	0.75		
32:	0.75		
33:	0.76		
34:	0.78		
35:	0.78		
36:	0.81		
37:	0.83		
38:	0.85		
39:	0.95		
40:	1.01		
41:	1.03		
42:	1.06		
43:	1.10		
44:	1.12		
45:	1.21		
46:	1.22		
47:	1.32		
48:	1.33		
49:	1.33		
50:	1.35		

PAGE TWO OF TWO

CLIENT.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-06
DEPTH/SAMPLE NO..3,361.5'-3,365' TYPE OF SAMPLE.....CORE; 1 ALPINE-FED.
LOCATION.....APACHE CO., ARIZ. DATE.....08-22-95
ANALYST.....K. W. SCHWAB NO. OF OBSERVATIONS. 60

STANDARD %Ro START: 1.02 FINISH: 1.02

REFLECTANCE DATA: MIN. 0.47 MAX. 1.87 AVG. 0.90 STD. DEV. 0.38



VITRINITE REFLECTANCE HISTOGRAM - %Ro

POP.# 1 TOTAL CTS. 38 MIN. 0.47 MAX. 0.85 AVG. 0.64 STD. DEV. 0.10 +

POP.# 2 TOTAL CTS. 8 MIN. 0.95 MAX. 1.22 AVG. 1.09 STD. DEV. 0.09

POP.# 3 TOTAL CTS. 12 MIN. 1.32 MAX. 1.60 AVG. 1.44 STD. DEV. 0.10

POP.# 4 TOTAL CTS. 2 MIN. 1.72 MAX. 1.87 AVG. 1.80 STD. DEV. 0.11

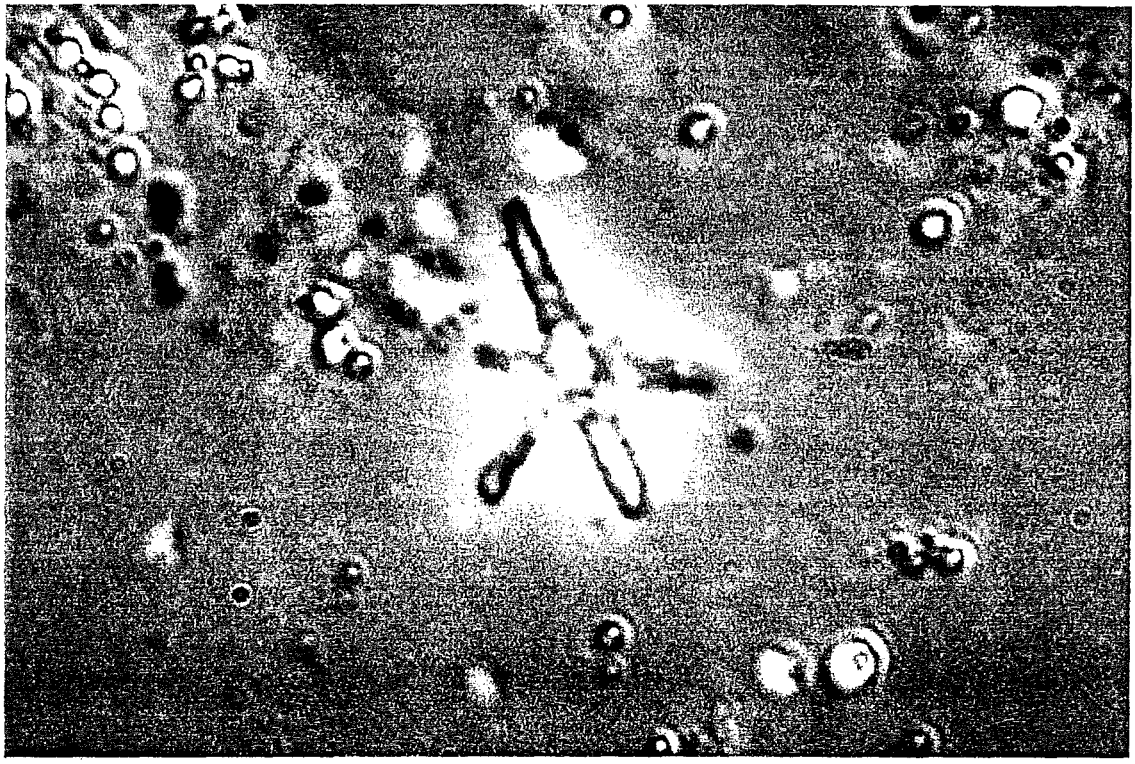
+ POPULATION CONSIDERED TO BE IN SITU

PAGE ONE OF TWO

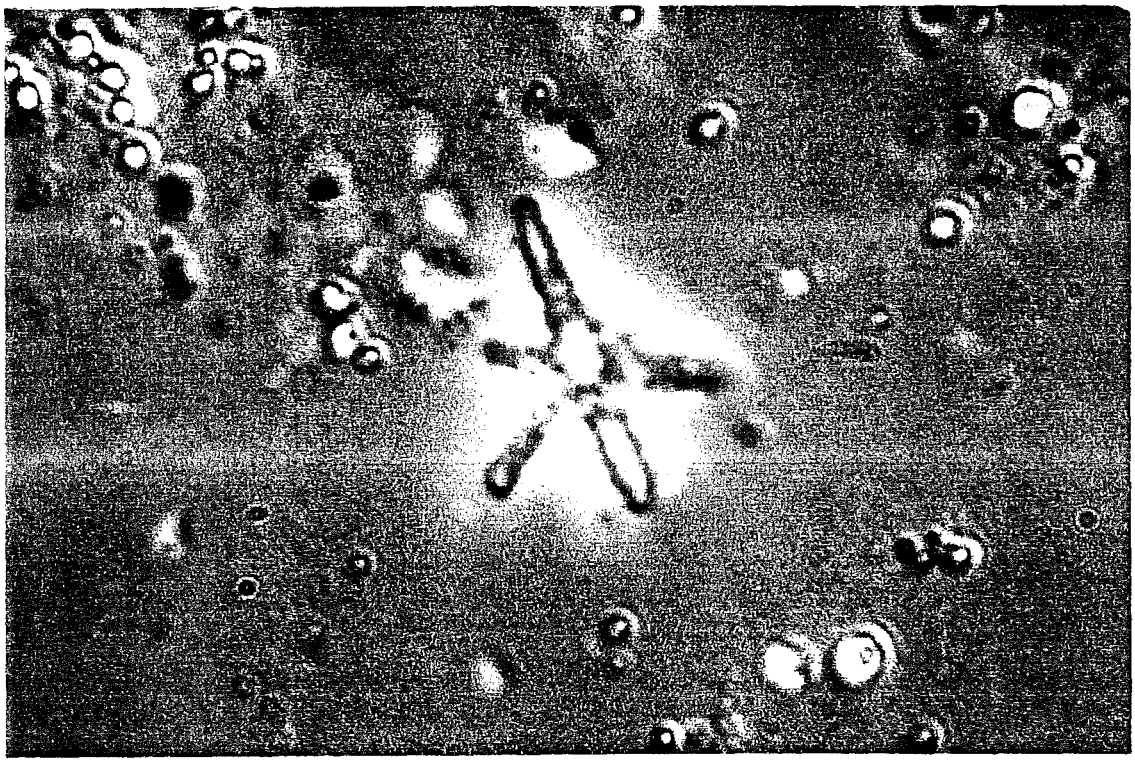
COMPANY.....ARIZ. GEOL. SURVEY FILE NAME.....AZ878-06

DATA POINTS:

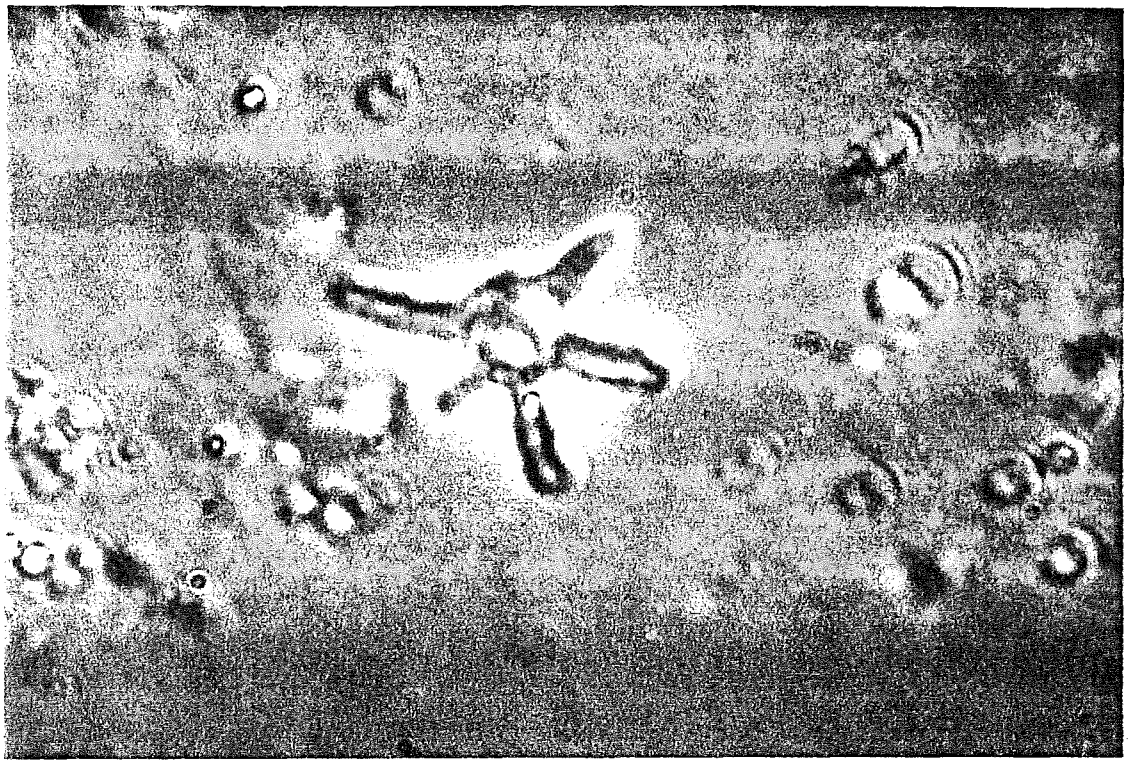
1:	0.47	51:	1.36
2:	0.48	52:	1.40
3:	0.51	53:	1.40
4:	0.52	54:	1.49
5:	0.52	55:	1.54
6:	0.53	56:	1.54
7:	0.54	57:	1.56
8:	0.54	58:	1.60
9:	0.54	59:	1.72
10:	0.55	60:	1.87
11:	0.55		
12:	0.57		
13:	0.58		
14:	0.59		
15:	0.59		
16:	0.60		
17:	0.61		
18:	0.61		
19:	0.62		
20:	0.63		
21:	0.64		
22:	0.65		
23:	0.65		
24:	0.66		
25:	0.68		
26:	0.68		
27:	0.70		
28:	0.70		
29:	0.71		
30:	0.72		
31:	0.75		
32:	0.75		
33:	0.76		
34:	0.78		
35:	0.78		
36:	0.81		
37:	0.83		
38:	0.85		
39:	0.95		
40:	1.01		
41:	1.03		
42:	1.06		
43:	1.10		
44:	1.12		
45:	1.21		
46:	1.22		
47:	1.32		
48:	1.33		
49:	1.33		
50:	1.35		



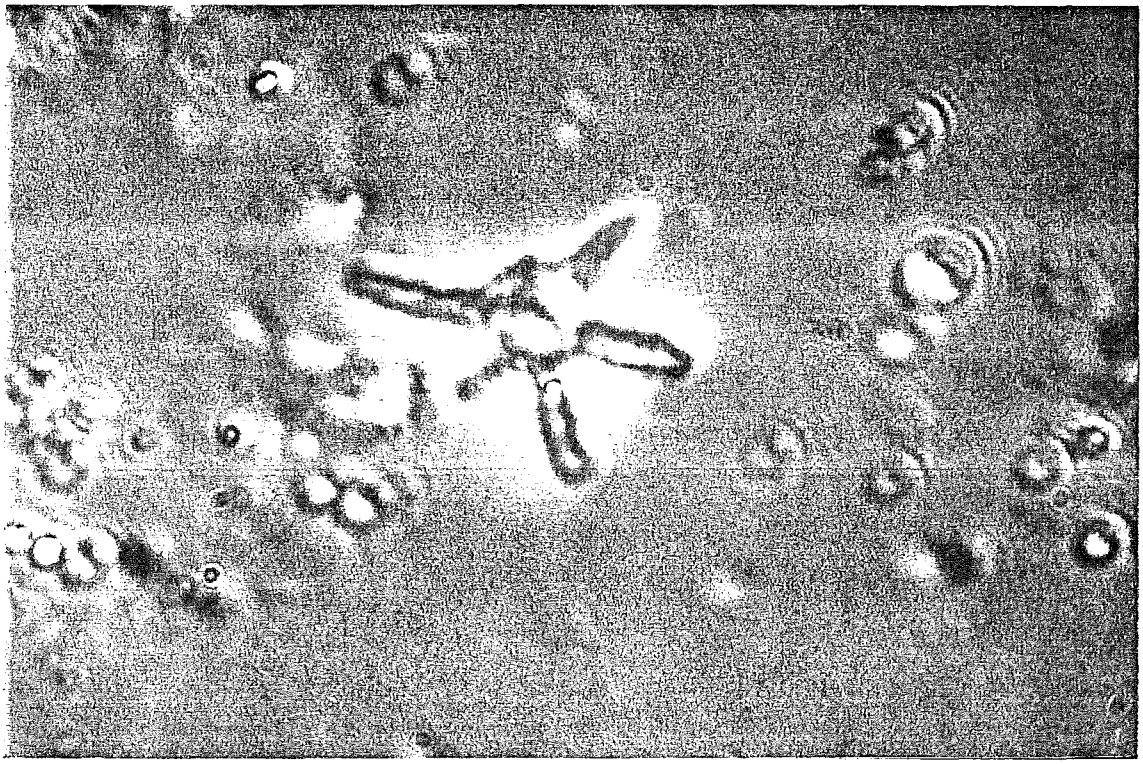
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



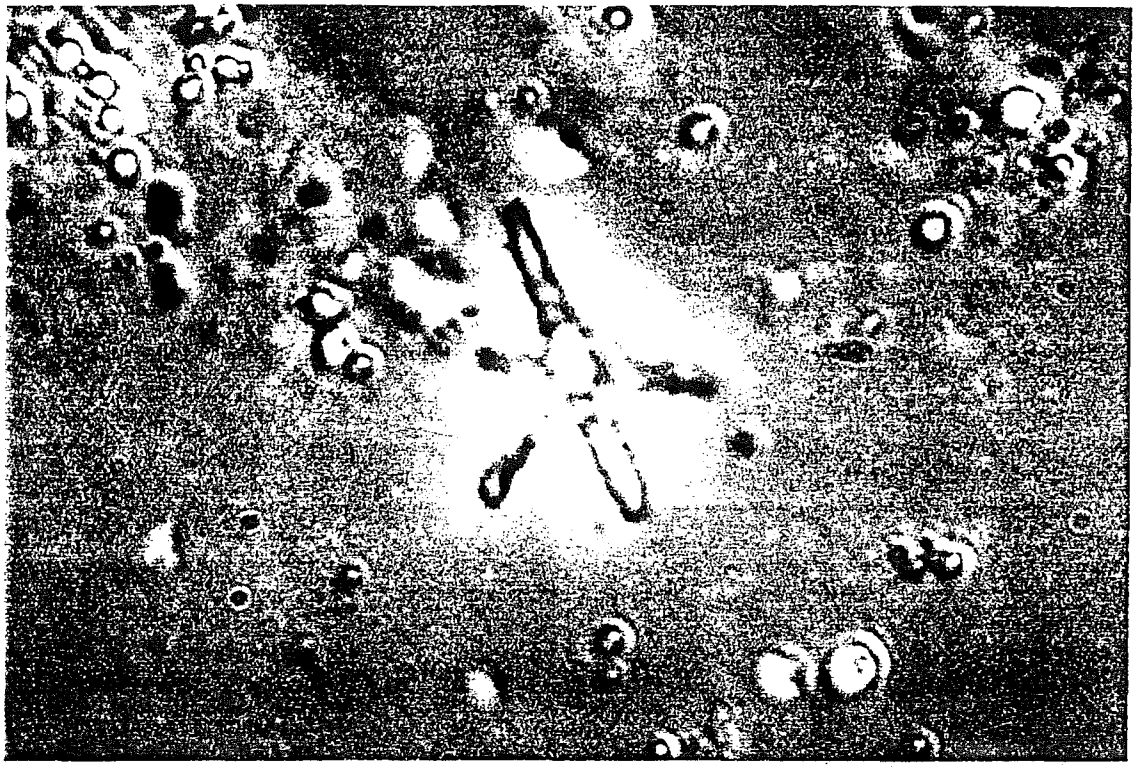
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



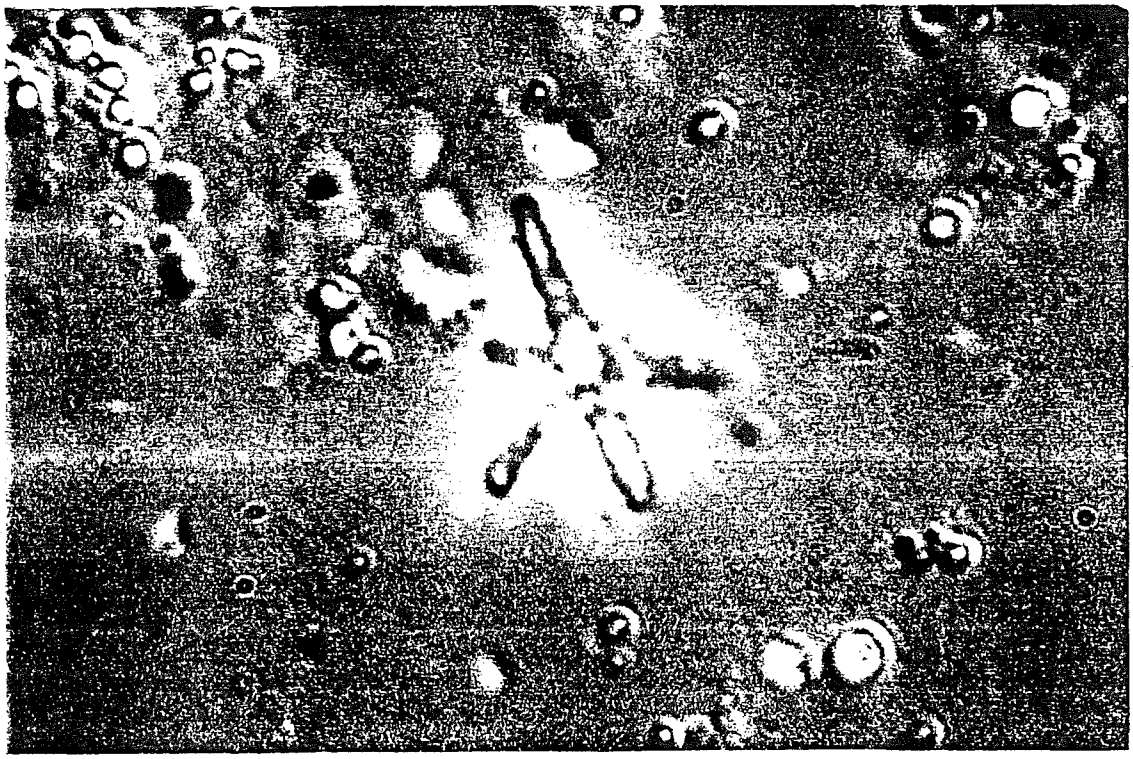
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



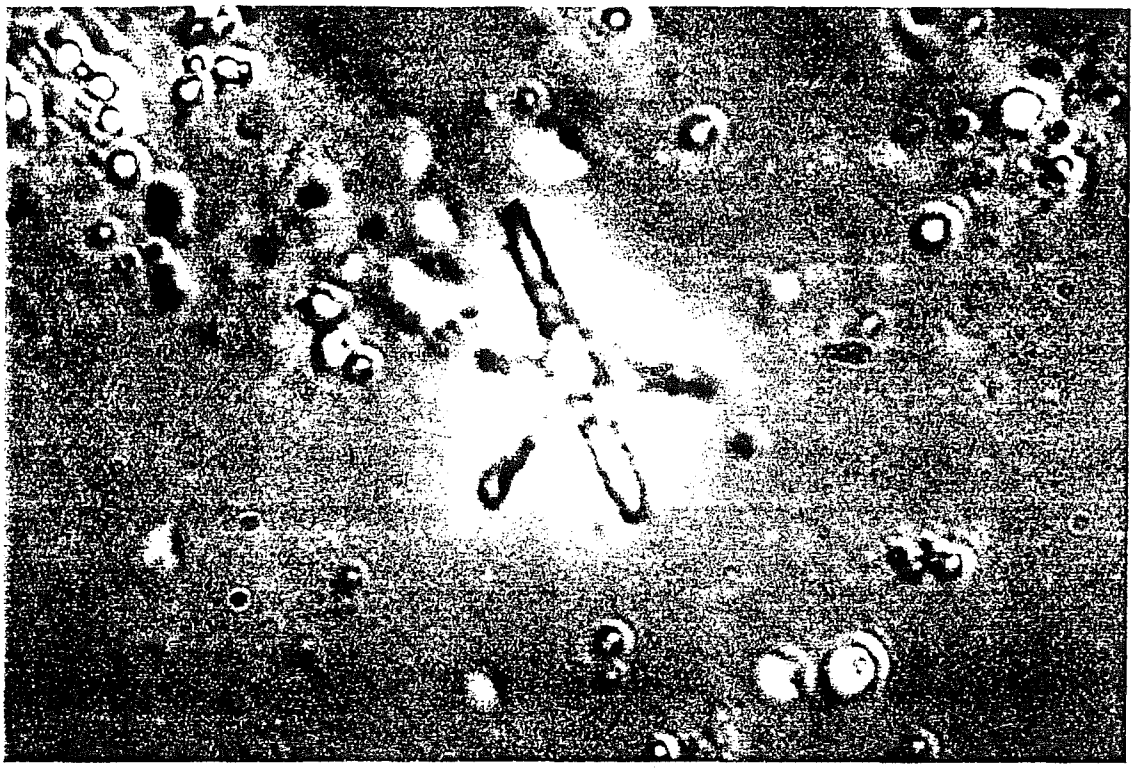
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



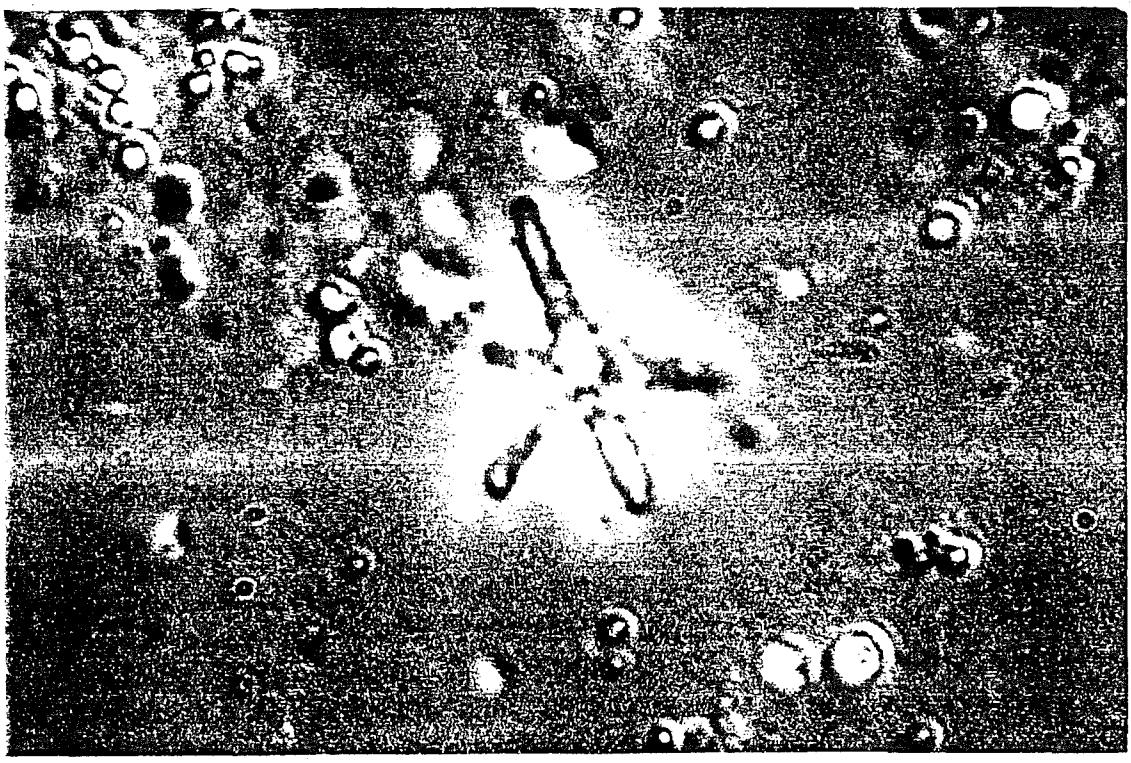
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



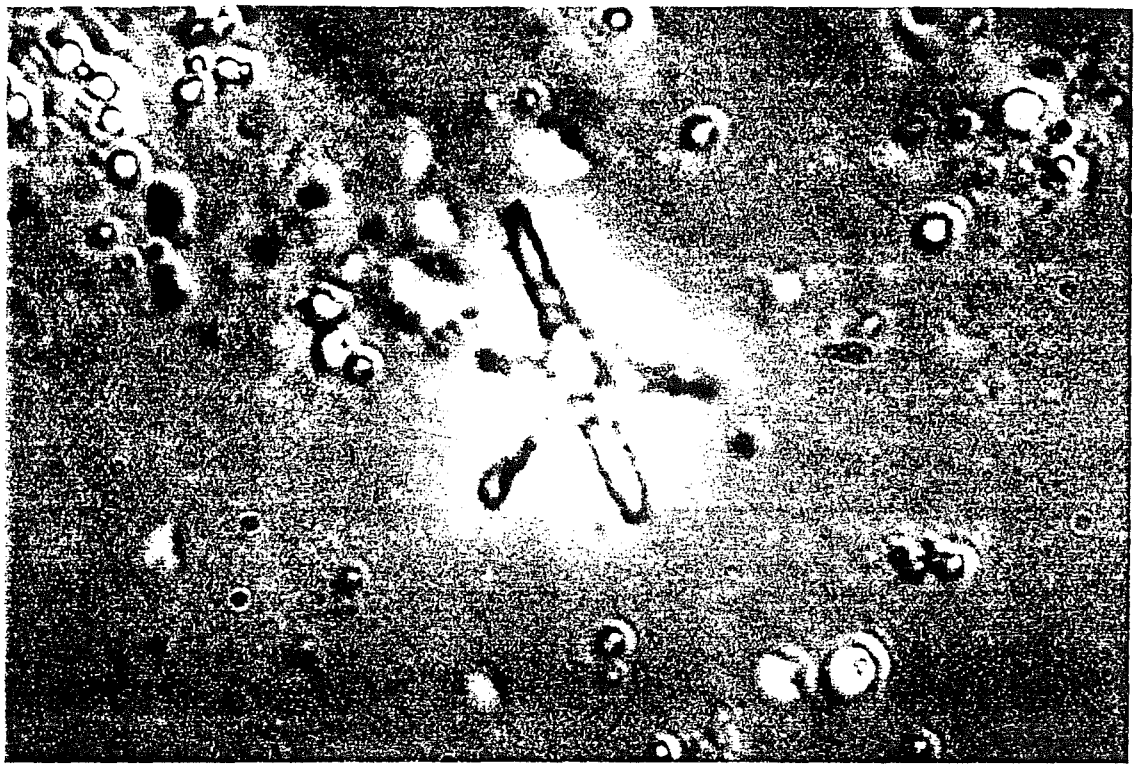
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



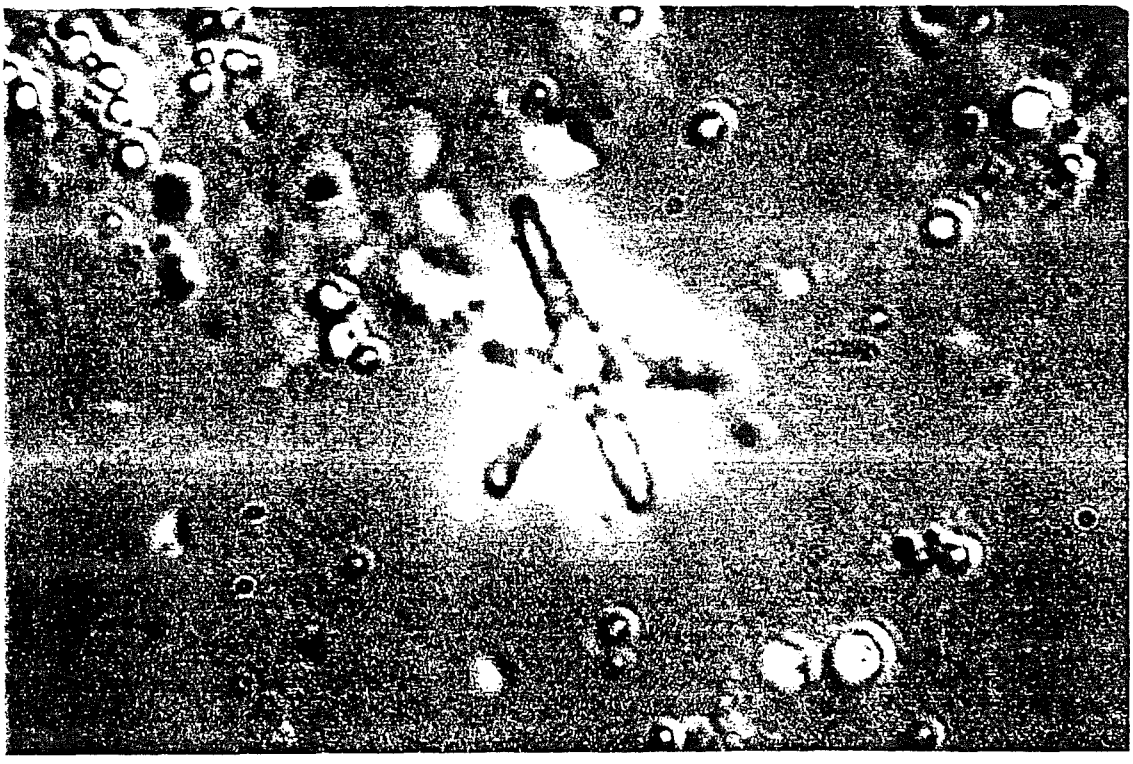
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



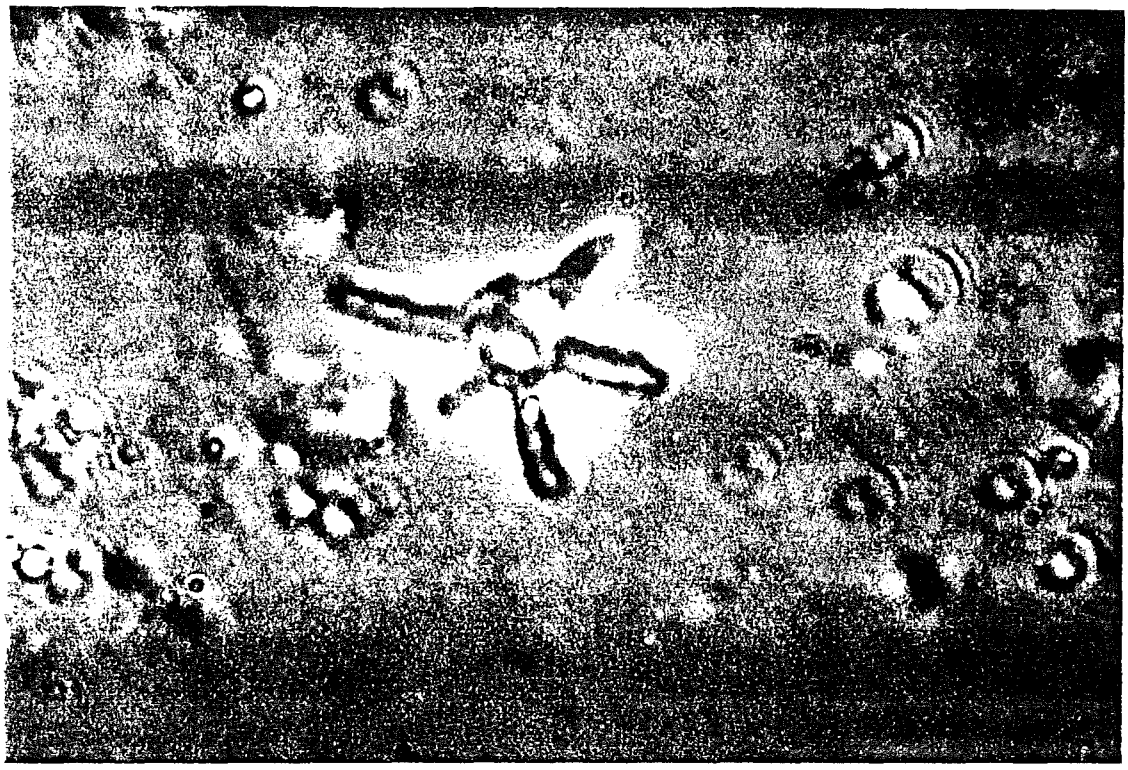
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



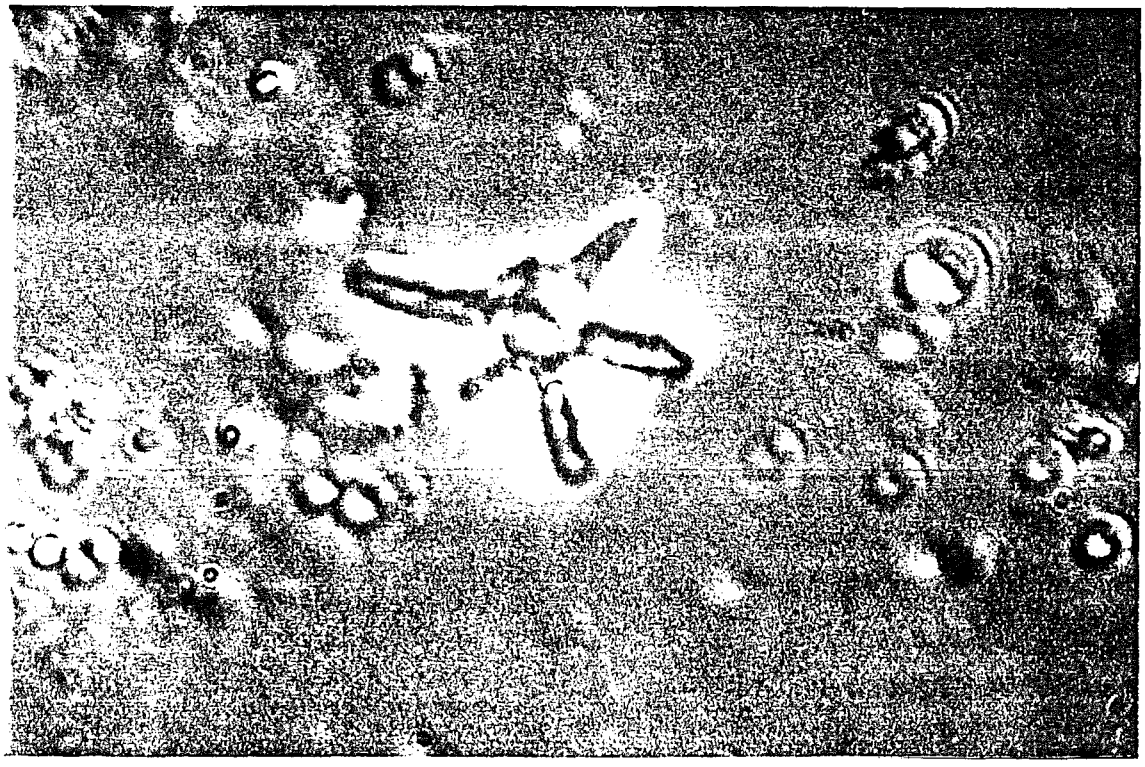
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



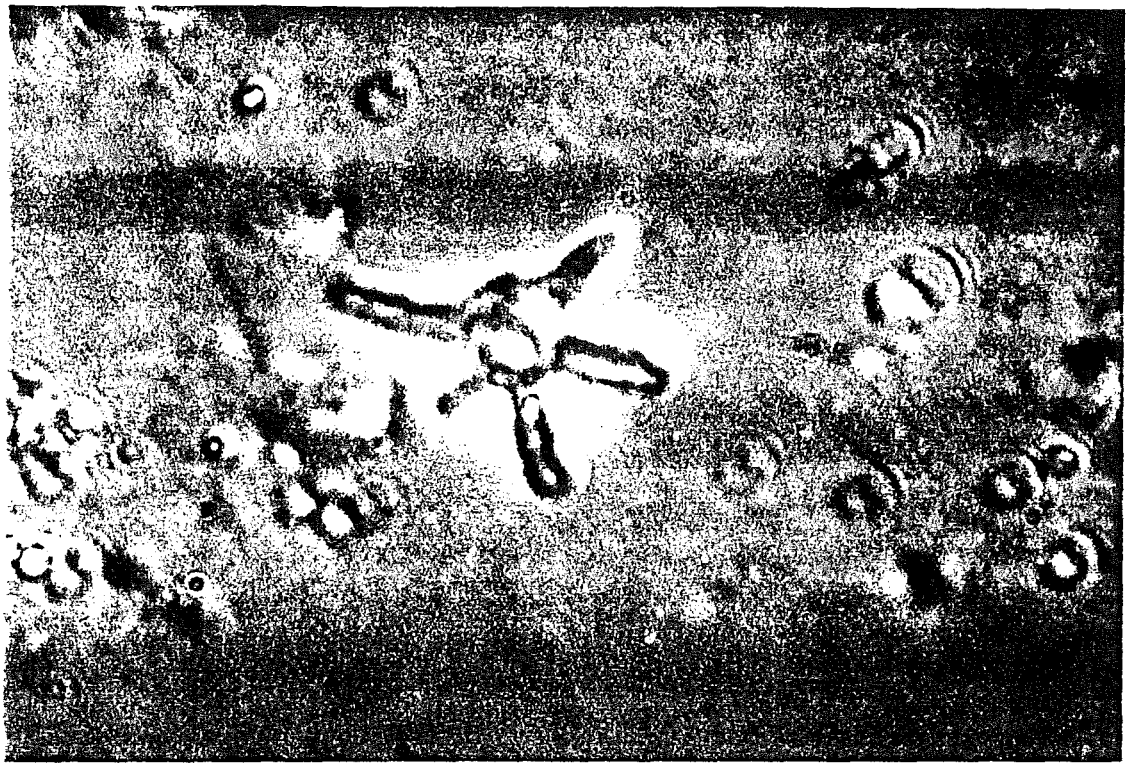
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



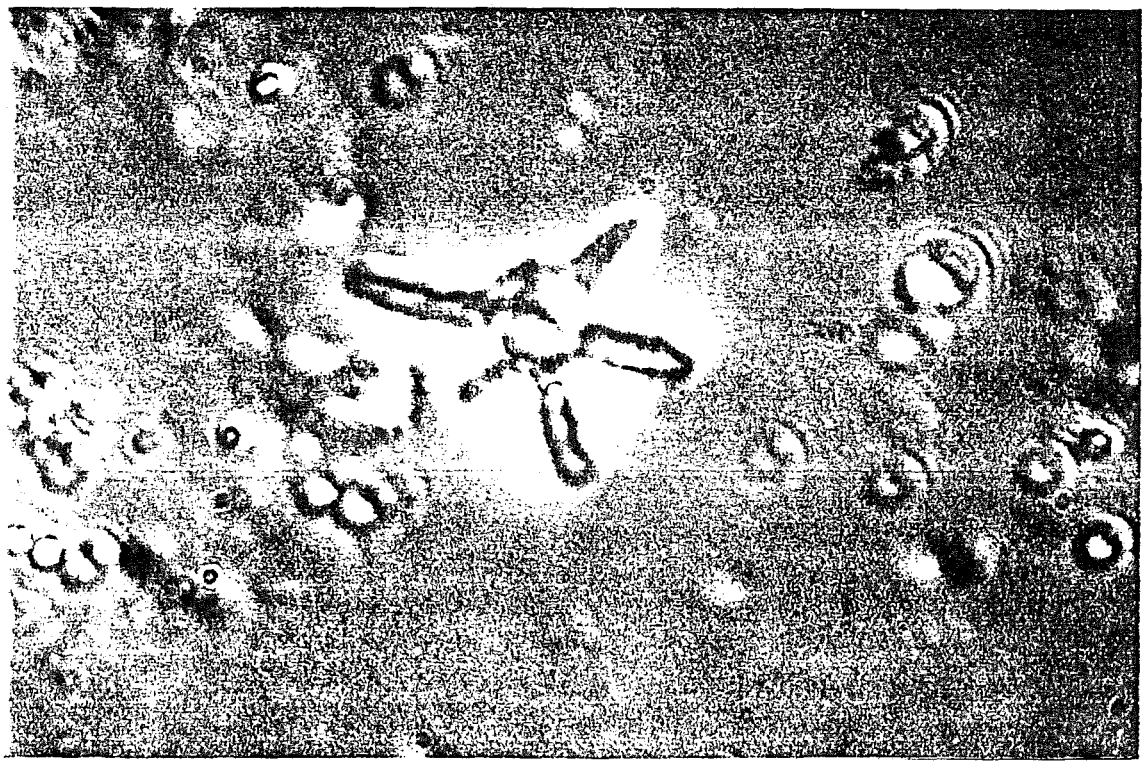
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



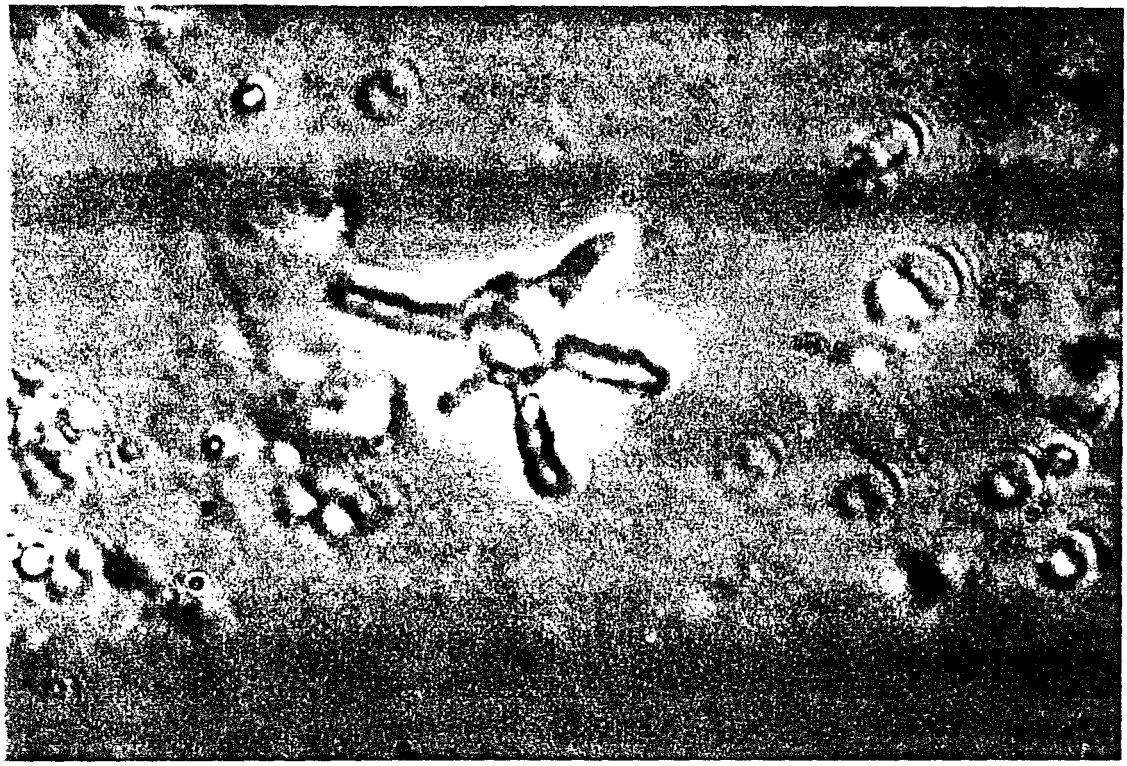
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



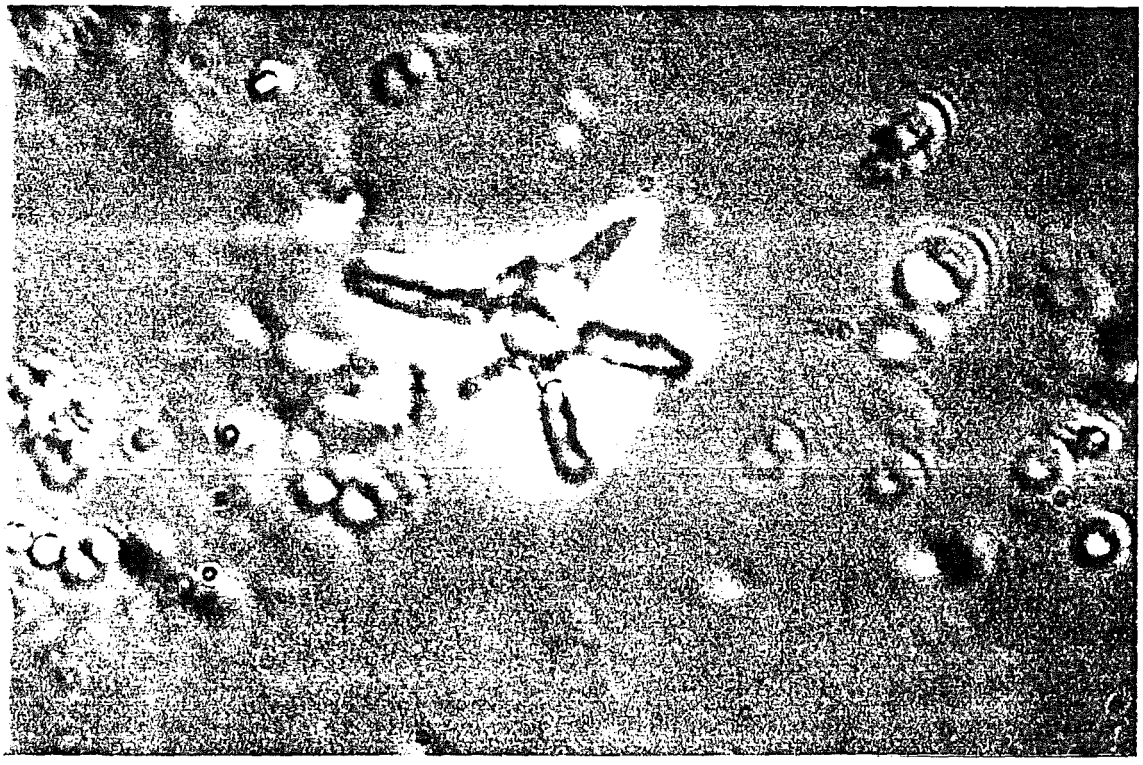
?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'



?Bukryaster (Discoaster) hayi
No. 1 Alpine Federal well
Apache Co., Arizona: 3,303-12'